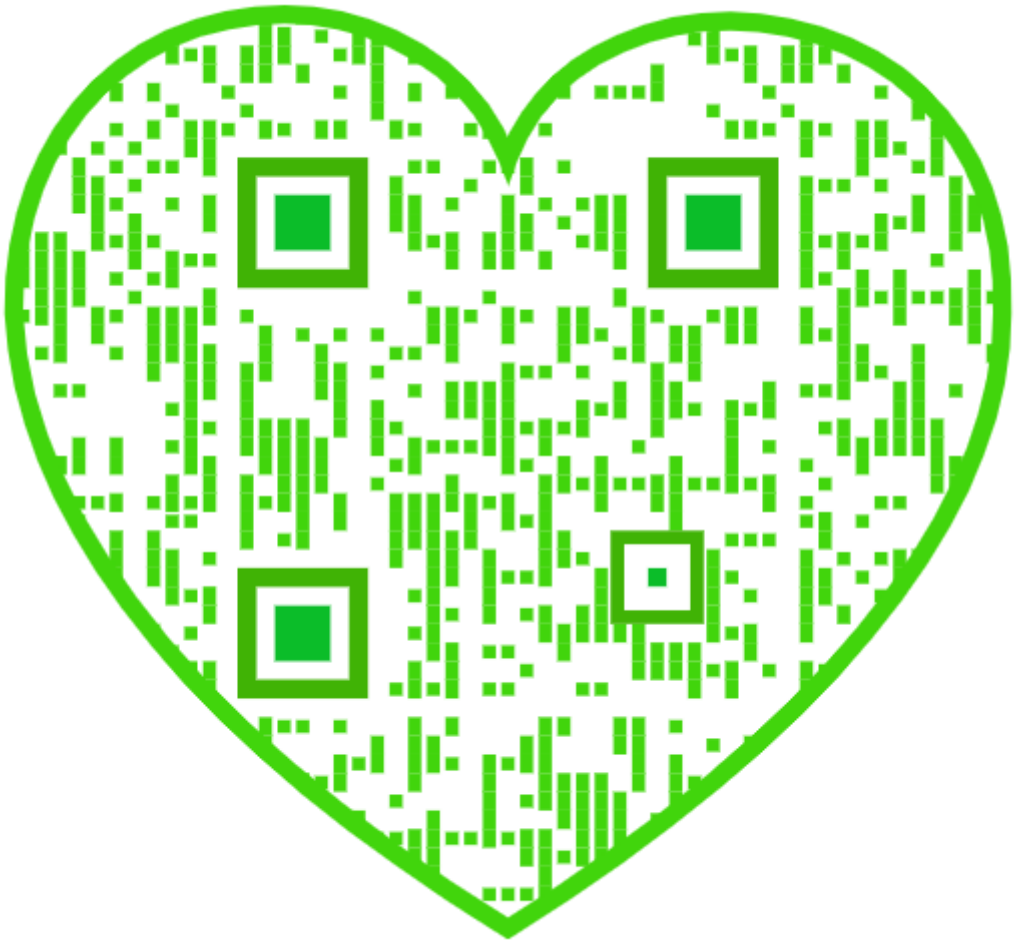

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THE A B C OF

CORN CULTURE

Or, Making Two Nubbins to Grow Where Only One Grew Before.

By Prof. P. G. Holden—Iowa State College.

THE WHITING TROPHY

PLANTING AND CULTIVATING | TESTING AND GRADING | HARVESTING AND STORING | INSECTS AND REMEDIES

FULLY ILLUSTRATED

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"And he gave it for his opinion, that whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind and do more essential service to his country than the whole race of politicians put together."—Dean Swift.

The Whiting Trophy

(SEE FRONT COVER PAGE)

Awarded annually by Hon. W. C. Whiting for the best ten ears of corn, any variety, exhibited at the Short Course, held at Ames, Iowa, the first two weeks in January, each year. Cost $450.00.

The Cook Trophy

(SEE BACK COVER PAGE)

This trophy, costing $1,600.00, was presented to the Iowa State College by Mr. A. E. Cook, of Odebolt, Iowa, and is awarded annually at the International Live Stock Exposition to the winning corn-judging team from any Agricultural College.

PRESS OF THE SIMMONS PUBLISHING CO., SPRINGFIELD, OHIO.

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OF

CORN CULTURE

BY

PROF. P. G. HOLDEN

IOWA STATE COLLEGE

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CHAPTER I

THE CORN CROP

Preparing the Ground, Planting and Cultivating the Crop

There is no one best method suited to all sections, or to the different soils of a section, nor even to the different fields of the same farm. Frequently two very different methods may give equally good results. There are no "ironclad" rules which may be followed blindly for the growing of corn any more than in other farm work. "Have good ground, do the work on time and do it thoroughly," should be the motto of every corn grower.

IMPORTANCE OF GOOD GROUND

Nothing can make up for poor ground. Too many are trying to raise corn on old "worn-out" ground that has produced corn, oats and wheat for years. I met a man at an institute in Illinois who said in all seriousness that he was satisfied the seasons were less favorable for corn growing than they used to be, as he could get no such crops as he used to raise. Inquiry developed that he had grown corn for seventeen years in succession on the same piece of ground. No wonder the "seasons were becoming less favorable."

Let us remember that it was but a few years ago that the farms of the corn belt were broken from the virgin soil, and that because we have been able to crop the ground continuously in the past is no assurance that we may continue to do so in the future with profit. The fact is that the time is near at hand when we must give greater attention to the fertility of our soil, to the conserving and restoring of the elements of plant food, or we shall soon be compelled to pay out millions of dollars annually for these elements in the form of commercial fertilizers, as is now being done in the East.

The tremendous importance attached to this question cannot be appreciated by those who have had no experience in the use of commercial fertilizers in the older settled parts of our country.

What is needed is *more clover, better use of barnyard manure,* and less of the *continuous cropping* with corn, oats and wheat.

FALL PLOWING FOR CORN

There is a great diversity of opinion regarding the merits of fall and spring plowing even in the same neighborhood. Among the advantages of fall plowing are the following:

First: The work is done at the slackest time of the year, when both men and teams would otherwise be idle.

Second: Having the ground already plowed in the spring gives us time to better prepare the ground, and, what is of equal importance, to get our corn in on time.

Third: A better prepared and a warmer seed bed, and consequently a better stand of corn.

Fourth: Less danger from insect enemies, especially in the case of sod ground.

Fifth: Weeds are prevented from seeding, and the seeds already in the ground will mostly germinate and be killed by the fall freezes before they have seeded. This is especially true of early fall plowing.

Some disadvantages of fall plowing are:

First: Occasional losses from blowing and washing on rolling ground.

Second: Unless the ground is disked early in the spring there is a loss of moisture and a consequent "firing" of the corn during the latter part of July and August, especially in dry seasons.

Third: The fall plowing does not give as good an opportunity to spread manure during the late summer and through the winter.

During the year 1904 the soils department of the Iowa State College conducted experiments with fall and spring plowing in different parts of Iowa, and in every case the yield of corn was greater on the fall plowing than on the spring plowing. The evidence is generally in favor of the fall plowing in the corn belt, but results will vary greatly with the method of handling the ground in the spring.

The mistake is commonly made of leaving the fall-plowed ground without disking until time to plant. The ground has become packed by snow and rain, and should be disked or har-

rowed as soon as the oat seeding is over. This will conserve the moisture and lessen the firing of the corn in August, so common to fall plowing.

Ground that is very rolling and likely to wash should not be plowed in the fall. Early fall plowing of stubble ground is usually advisable when the ground is very weedy. In the corn belt, where the area put into corn is large and the corn-planting period is short, it is the best kind of management to plow all stubble and sod ground in the fall.

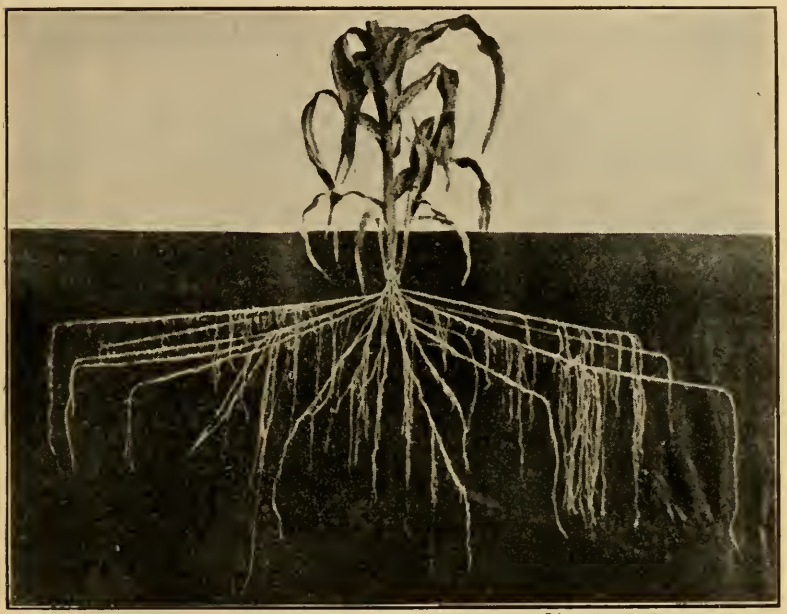

Photo by A. D. Shamel.

FIG. 1—Root development of a single corn plant at time of "laying by." The roots do not run straight down from the stalk, as many suppose. Deep cultivation the first time over the field will not injure the corn; it will clean the ground and leave a good mulch. The experiments all show that deep cultivation after this always reduces the yield.

LATE PLANTING BAD

We should bear in mind that one of the most serious losses to the corn crop every year is due to late planting. Experiments show that late-planted corn seldom yields as much as that planted earlier, and the quality is inferior. The ground becomes hard and out of condition, the weeds have drawn upon

the moisture and available plant food, the crop comes to the dry spell in a more critical stage, the proportion of barren stalks is greater, and it matures more slowly, contains more water and is much more likely to be caught by the frost.

Every year thousands of farmers lose heavily from late planting. Many of these are good farmers, but are unexpectedly delayed with the spring work, by a combination of bad weather, sick horses and scarcity of help.

This matter of readiness in the spring is of great importance in the corn belt, and is made all the more so because it is practically impossible to secure outside help at this time of the year.

PLOW STUBBLE GROUND EARLY

Let me say again, it is generally advisable to plow stubble ground early in the fall.

First: Because the weeds which have been started will be prevented from seeding, and the weed seeds will be brought near to the surface, where they will germinate and be killed by the frost before they have seeded in the fall.

Second: This second growth of volunteer oats, weeds, etc., will protect the ground during the winter and keep the soil from blowing. The late fall plowing has no second growth and blows worse in the winter.

Third: There is more spare time for the work. If the stubble ground is left for late fall plowing it is apt to crowd the plowing of sod over into spring, which is bad practice generally.

LATE FALL PLOWING BEST FOR SOD

The reasons for plowing sod ground in the late fall are:

First: It gives us the benefit of late summer pasture, and in case of clover a second crop for seed or to turn under to enrich the ground.

Second: It is the best possible place to spread the barnyard manure during August and September, as there is the least danger of washing or leaching.

Third: The ground can be much better prepared and with less work than when plowed in the spring.

Fourth: There is less danger from damage by cutworms and other insect enemies. There are many instances this year

where the ground froze last fall before the plowing of the field was completed. The corn on the portion that remained over and was plowed in the spring was frequently greatly injured by cutworms and had to be replanted.

It may often be advisable to leave some ground on which to spread manure during the winter. In this case it had better be the clover sod rather than the timothy or the blue grass.

Where clover is seeded with the oats or barley for fertilizing

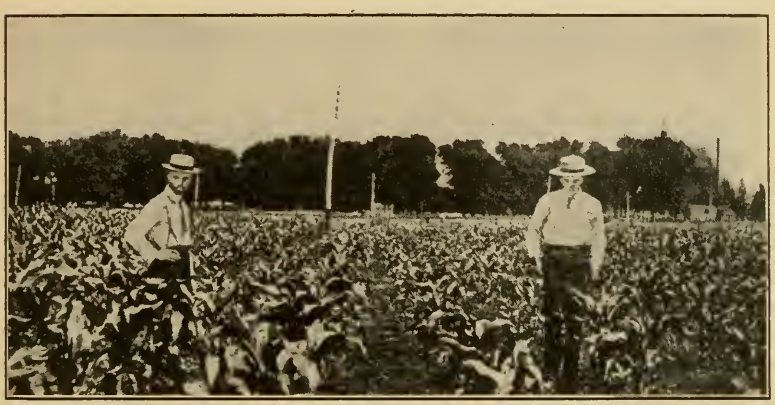

Fig. 2—The effect of injury to the corn roots. The corn in both strips received ordinary cultivation. The strip on the right was root-pruned four inches deep—that is the roots were cut, or pruned, with a rolling cutter adjusted to run four inches deep and about seven inches from the row. The root pruning was done after each cultivation and in the same direction as the cultivator was run. The difference in the growth of the corn is very noticeable. The experiment was repeated four times. The corn root-pruned four inches deep yielded fifteen bushels per acre less than that which was not pruned. Scores of carefully conducted experiments all go to show that injury to the roots reduces the yield of corn. The greatest damage is generally the result of allowing the shovels next to the row of corn to run too deeply, especially during the last two cultivations. Many seem to think that because they are "laying by" the corn, and will not get another chance at it, they must give it what is called a "good laying by." Injury to the roots also tends to make the corn later in maturing, chaffy and inferior in quality.

purposes, or where rape is sown in the oats for fall feed, it will, of course, be necessary to plow late in the fall.

BETTER ATTENTION TO FALL-PLOWED GROUND

The fall-plowed ground is often neglected in the spring and left to dry out, and the weeds are allowed to get a good start, robbing the ground of moisture and food. Not only should the fall plowing be disked as soon as oat seeding is over, but the corn stubble as well. When cornstalk ground is disked early in the spring the moisture is saved, the stubs are cut up and mixed with

the soil, giving less trouble during cultivation, and a better seed bed is secured, also. If not disked, the surface is turned to the bottom of the furrow in a lumpy condition, where neither harrow, disk nor cultivator will reach it.

SPRING PLOWING ABUSED

We often abuse our spring plowing by turning the earth up to the sun and dry winds to bake and dry out, depending upon a shower to mellow the ground before planting time.

With spring plowing it is a good rule never to leave the field at noon or night without harrowing the ground that has been plowed. In my estimation no ground can be properly prepared, giving a good seed bed for corn, without the use of the disk. A half-prepared seed bed means a poor stand of corn and an uneven growth, and the corn will suffer more from drought and other unfavorable conditions.

DEPTH TO PLOW

What is known as deep plowing is not advisable in the corn belt, although the loose soils and bottom lands may be plowed much deeper than the heavy clay soils or the black prairie soils with less danger of bad results. There is seldom any advantage in plowing more than six inches deep, either in spring or fall. If the ground is to be plowed deeper than formerly, it should be done in the fall. On heavy soils the bad effects of too deep plowing are often apparent for several years.

TOO DEEP PLANTING

Too deep planting is especially bad when the seed is weak or the spring is cold and backward. When the ground is not well prepared or is very mellow, there is danger of putting the seed down four or five inches when two inches would be better. Especial care should be taken in case of early planting when the ground is still cold.

There were several cases last spring where the seed from the same sack was planted in two different fields, giving a good stand in one and a very poor stand in the other. Investigation showed that the poor stand was due to deep planting. Corn is generally planted deeper than we think. The planter wheels

frequently sink into the earth two or more inches and the corn is covered another two inches. The planter tracks are then filled in by harrowing the field, and the corn is often more than four inches deep. We often watch the planter carefully for a few rounds, then pay no more attention to the depth of planting. The soil is mellower as we get away from the headland, and consequently the corn is planted deeper than we supposed.

A DRY, MEALY SURFACE BAD

On the other hand, there is no more serious mistake than shallow planting in lumpy, dry, mealy soil. The moisture is

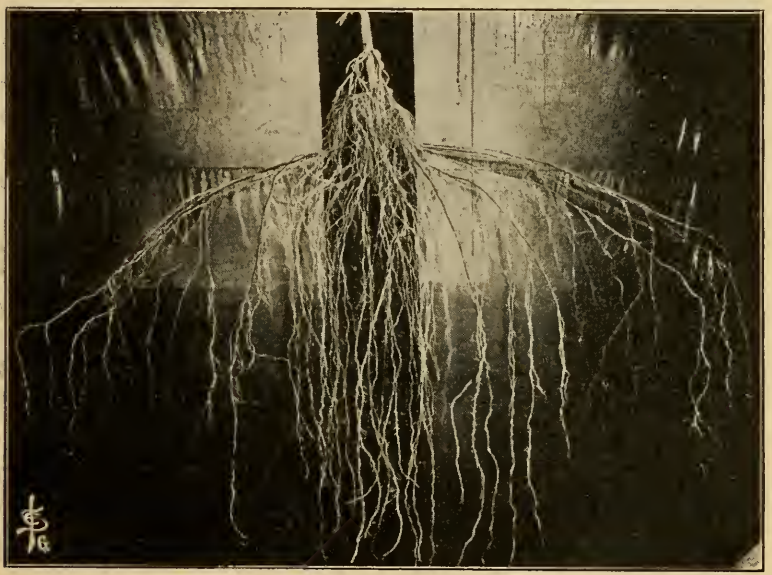

Fig. 3—Photograph of the famous corn plant in the Iowa exhibit at the Louisiana Purchase Exposition. This shows the root development of the plant when the corn is in the milky stage. Many of these roots are more than five feet in length.

not sufficient for rapid germination, the seed soaks up slowly, much of it sours or rots, and the remainder comes up unevenly with a large per cent. of sickly plants. This condition is most frequently found where the spring plowing was not followed by the harrow the same day or where the disk was not used in preparing the seed bed, and especially when these two conditions are accompanied by a dry, cold May.

STRAIGHT ROWS AND EVEN CHECKING

The yield of corn is often reduced and the work of cultivation made slow and difficult because of carelessness in handling the planter. Uneven checking may be due to several causes. In the case of short fields we generally draw the wire too tight and the planter checks too quick both ways. On long fields we are apt to check ahead, owing to slack in the wire, and this is especially true where the tongue of the planter is raised too high and the team walks fast. In the case of irregular shaped fields the checking is apt to be bad. This is especially true where the ends of the field are not at right angles with the rows. In this case there will be a jog every four rows, the amount depending upon how much the field is out of square.

Carelessness in setting the anchor is the cause of much poor checking. It is a common practice to draw the wire about so tight at both ends of the field. It is a much better plan to always set the anchor on line at one end of the field, while at the other end the anchor should be drawn to a certain tightness.

CULTIVATION

Cultivation should be level and frequent when the corn is small. It may be deep at first, but it must be shallow later.

It is not possible at this time to go much into details, and of course methods will vary greatly with local conditions, but there are a few things of importance that are often overlooked.

Many assume that there is nothing more to do after the corn is planted for two weeks, or until it is up and large enough for the first cultivation. There are others who believe in harrowing, and even in cultivation, before the corn is up, but on account of the pressure of work neglect it. Where ground is left two weeks and often longer it becomes foul with weeds, which take up the moisture and plant food and also make it difficult to work the corn. The ground becomes packed by the rains and baked by the sun until it is hard and dry—that is, "out of condition."

It is especially important in the case of corn that it should not become stunted when young, as it never fully recovers even under the most favorable conditions.

We should keep a good, mellow, lively tilth until the corn shades the ground, preventing the rain and sun from beating upon it, making it hard, dry and mealy.

The time to kill weeds is before they come up and before they have deprived the corn of moisture and nourishment.

CULTIVATE BEFORE THE CORN COMES UP

Where it is possible to do so it is a good plan to cultivate the corn once before it comes up, following the cultivator with the harrow. If the piece is so small that the cultivation can

Photo by A. D. Shamel.

FIG. 4—Four hills of corn at earing time, in natural position in the field, three feet eight inches apart. The surface soil was washed off as deep as the ground was plowed in the spring, exposing the roots. Few realize how completely the ground is filled with the corn roots. Thorough *early* cultivation before the roots have developed is important. Experiments show that deep cultivation at the time of "laying by" greatly reduces the yield, especially when the first and second cultivations were shallow, thus allowing the roots to come near the surface.

be finished before the corn breaks through the surface, it is well enough to wait until the field is all cultivated and then cross it with the harrow instead of following close behind the cultivator. However, in the case of large fields it is best to follow the cultivator with the harrow. This practice of cultivating the field before the corn is up, following the planter marks as a guide, is a good one, and especially on old and badly worn ground or heavy clay ground and on land that has become foul.

It is a common practice with some to harrow corn after it

is up, but I prefer to cultivate and harrow as described above, especially on cornstalk ground. Even on stubble ground the harrow does considerable damage to the young corn. No one can afford to do less than to thoroughly harrow the ground before the corn comes up. It is a *serious mistake* to let our corn ground *get out* of condition in the spring.

It is also a very common mistake to cultivate shallow when the corn is small and "lay it by" with a deep cultivation. The reverse will be more profitable. There is little danger to the roots from deep cultivation the first time, and there is great advantage in going deep enough to secure a good mulch.

The later cultivations should be no deeper than is necessary to keep the ground clean. Many cultivate corn as though the

FIG. 5—"A rotation which does not include clover is hardly worthy the name." Photo taken June 20th. The corn on both sides of the road was planted the same day and with seed from the same sack. The field on the right has been in corn continuously for three years. The field on the left is on clover sod, plowed in the fall. The rotation is clover, corn and oats, one year each. *First*, the corn is much more vigorous on the clover-sod ground, and has a deeper green color; *second*, at this time (August 13th) the clover-sod corn is standing up well, while the third-year-continuous corn is badly down, due to the work of the corn-root worm.

roots went straight down instead of spreading out through the surface of the soil. It is very essential that we disturb the roots as little as possible when the corn is laid by. We are very apt to feel that as this is our last chance at the corn we must give it a "good laying by," and especially if the weeds have gotten a start.

AFTER-CULTIVATION NOT PROFITABLE

After-cultivation—that is, the cultivation with a one-horse cultivator after the corn is too large for the two-horse cultivator—is not good practice generally. Even if the weeds have gotten a start, they will do less damage to the corn than will be done by the root pruning of the cultivator. The weeds have

already done their greatest damage except in seeding for next year. The damage will frequently be considerable from the breaking down of the corn, and especially if it has been injured by the root worm or by the white grubs or wireworms and has gone down in places.

RAPE IN CORN PROFITABLE

The sowing of rape in corn at the time of laying by is coming rapidly into more general practice. The rape should be sown at the rate of six or eight pounds per acre, before the corn is laid by and cultivated in. Where the seed is sown broadcast it is well to sow down through the field and back in the same place, sowing but half enough seed the first time and the other half coming back. This will insure a better distribution of the seed.

After the middle of September the lambs may be turned in to pasture the rape and the lower leaves of the corn, but it will be a better practice generally to allow the rape to grow until the corn is husked, and then turn in the sheep, hogs, and cattle other than milch cows. In this way a remarkable amount of sheep and hog feed is produced at comparatively little cost.

CHAPTER II

PREPARATION OF THE SEED FOR THE PLANTER, OR MAKING TWO NUBBINS OF CORN TO GROW WHERE BUT ONE GREW BEFORE

Poor seed means a poor stand, with missing hills, one-stalk hills, and weak stalks producing little or nothing. It means wasted land and wasted labor; it means less than thirty bushels of corn per acre in this "corn belt" instead of forty or fifty bushels.

In this chapter I shall attempt to describe the methods which have done most to enable us to produce "another nubbin of corn to each hill." I shall spend little, if any, time discussing those things which we do well enough ordinarily, but I do want to jog you to the importance of doing three or four simple things which most of us have failed to do in the past, but must do in the future if we are to secure the greatest possible returns for each year's labor and from each acre of land.

YIELD OF CORN IS LOW

The average yield of corn in the United States is less than twenty-five bushels per acre, yet there are hundreds and thousands of farmers who produce sixty and seventy, and even eighty and ninety, bushels per acre. I have in mind scores of instances where of two fields just across the road from each other, or perhaps adjoining, but on different farms, one yielded more than seventy bushels and the other less than twenty, yet the land values were the same and the labor required to produce the twenty-bushel crop as great as to produce the seventy-bushel crop. If one man can produce sixty and seventy bushels per acre, the other man can do it also, and not only that, but must do it if we are to achieve our agricultural possibilities.

A POOR STAND, AND WEAK STALKS PRODUCING LITTLE OR NOTHING, IS THE GREATEST CAUSE OF A LOW YIELD OF CORN

In the corn belt it is customary to plant corn in hills three and one-half feet apart each way, three kernels per hill, thus

making 3,556 hills to the acre, or 10,668 stalks if each kernel grows. If two of the stalks in each hill bore nothing, but the other grew a very small ear weighing only eight ounces (140 ears to the bushel), we would then have twenty-five bushels per acre, or more than the average for the United States. What we must do is to make at least two of these three stalks produce an eight-ounce ear each, and we will have over fifty bushels per acre; and there are many who will not be content until they have two of those stalks produce a twelve-ounce ear each and

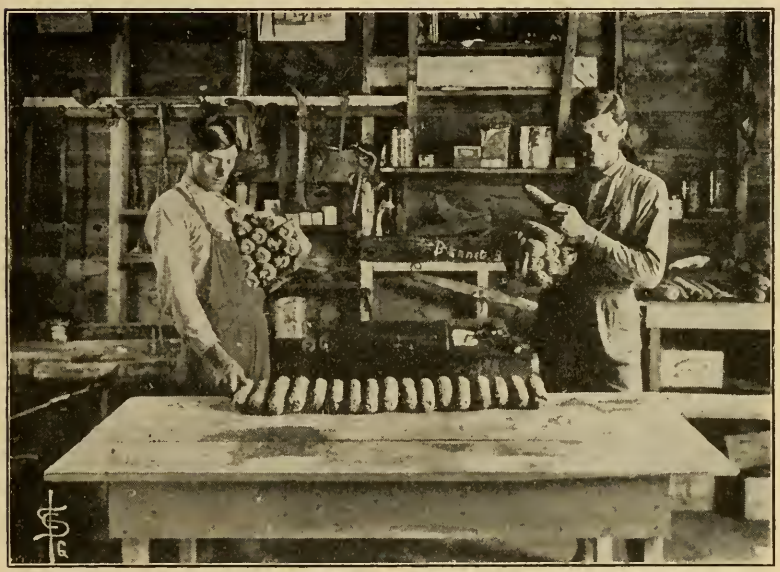

Fig. 6—First Step in Preparing Corn for the Planter. Laying out the Ears on the Table for Study.

the third an eight-ounce nubbin, making one hundred bushels per acre. This has often been done in the past, and it will be a common thing in the future.

One twelve-ounce ear per hill will make thirty-eight bushels per acre. Think of it for a moment. Last year Iowa produced one of her most magnificent crops of corn, yet if two of the three stalks per hill produced nothing and the other bore a medium-sized ear weighing only twelve ounces, we would have thirty-eight bushels per acre, or more than the average yield of this

great crop. Iowa must produce another nubbin to the hill, and so must the rest of the United States!

A good stand of corn, and every stalk producing just a medium ear, as I have illustrated, will give us a good yield of corn of fifty, sixty, or even seventy or eighty, bushels per acre. Then why are we not getting it?

First: Because there are too many missing hills and one-stalk hills—hills that are producing nothing or only half what

FIG. 7—Second Step. Discarding the Poor Ears.

The ears should be laid out side by side, and two or more kernels removed from each ear and placed in front of their respective ears. By then examining the ears and kernels, the undesirable ears may be discarded. The importance of giving careful attention to this work can hardly be overestimated. In order to make a good selection it is necessary in the fall to save several times as much seed as will be required to plant.

they ought to. The fields which I have examined in the great corn belt show that there is on an average more than one-third of the ground put into corn that is producing nothing, yet it must be cared for all summer, yielding nothing in return.

Second: Because there are many thousands of stalks in our fields that are barren, producing no ears, and then there are many thousands of other stalks producing only small, inferior ears, yet they must receive the same care as the productive ones.

After having studied thousands of corn fields throughout the corn belt during the last nine years, I have no hesitancy in saying that a "poor stand" and "weak and barren stalks" are responsible more than anything else for the low average yield in the Central West. The ground may be rich, the preparation good, and the corn receive the best of cultivation, but if the stand is poor and the stalks are weak and sickly the yield will be correspondingly poor.

COUNTS IN THOUSANDS OF FIELDS

Careful counts of the number of stalks per hill have been made during the last three years in thousands of different corn

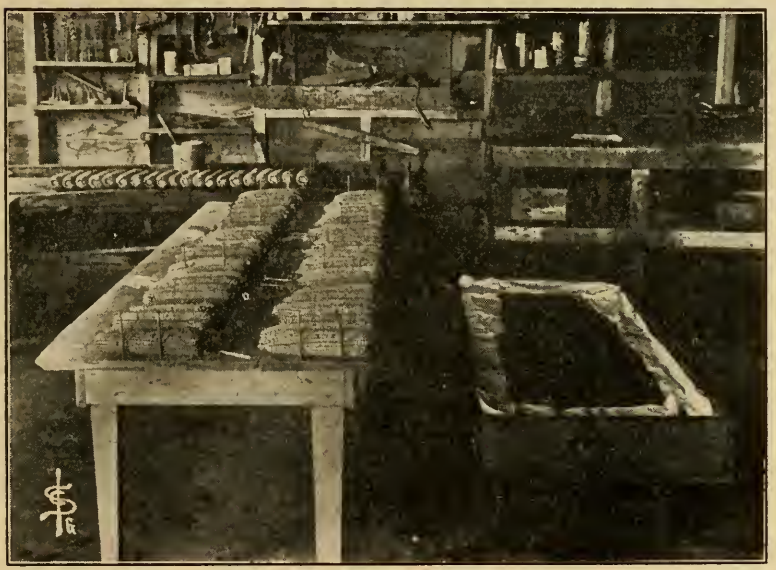

FIG. 8—Third Step. Six Kernels Have Been Taken from Each Ear and Placed in the Germination Box.

fields, and it is safe to say that there were not to exceed sixty-six per cent. of a perfect stand on an average, and in many cases it fell as low as forty per cent. This means that Iowa alone devoted nine million acres to corn and produced only a six-million-acre crop, or, to put it another way, with a perfect stand the present average yield of thirty-two bushels for the past ten

years would be increased to fifty bushels per acre, or an increase to the state of one hundred and fifty-three million bushels. This does not take into consideration the increased yield made possible through the use of improved varieties, better bred seed, elimination of barren stalks by means of breeding, better methods of cultivation, etc.

The real seriousness of the situation will be more apparent from the following counts illustrating the stand in the poorer, medium and better fields of Iowa. The following figures give

Fig. 9—Fourth Step. Shelling Off the Butt and Tip Kernels.

the number of stalks per hill in the poorer fields: 2, 2, 2, 0, 3, 2, 0, 1, 3, 0, 1, 1, 1, 3, 1, 1, 0, 2, 3, 0, 1, 2, 1, 0, 0, 2, 1, 3. Each of the first three hills had two stalks, the fourth hill was missing, and the next had three stalks, etc. That the result might be as accurate as possible, counts similar to the above were made in three places in each field. The hills were taken just as they came in the row, and generally crosswise of the way the corn was planted. The field above represents only fifty-two per cent. of a stand of corn. Twenty-five per cent. of the hills were miss-

ing, thirty-five per cent. had one stalk, twenty-five per cent. had two stalks, and twenty per cent. had three stalks, per hill. If the poor stand was largely due to seed of low vitality, which is generally true in case of very poor stands, then the same influence which killed a portion of the seed must also have greatly weakened that which did grow, and as a consequence the yield is of far less value than is represented by the stand.

The above represents what is found in hundreds of corn fields everywhere. The following will illustrate very closely the

Fig. 10—Fifth Step. Shelling Each Ear Separately, and Grading to Three Sizes of Kernels —Large, Medium and Small.

average stand in the state: 2, 3, 1, 2, 1, 0, 1, 1, 3, 3, 1, 3, 1, 2, 2, 2, 3, 0, 3, 1, 2, 0, 2, 1, 2. On the average soil of the state this would represent about sixty-five per cent. of a stand of corn. Twelve per cent. of the hills were missing, twenty-eight per cent. of the hills had one stalk, thirty-two per cent. of the hills had two stalks, and twenty-eight per cent. of the hills had three stalks.

The following represents the stand in one of the very best fields in the state: 3, 4, 3, 2, 1, 3, 3, 3, 3, 2, 3, 3, 3, 3, 3, 2, 3,

3, 3, 3, 3, 3, 3, 3, 3. In this field there were no hills missing, four hills had one stalk, twelve had two stalks, seventy-six had three stalks, and eight hills had four stalks. This represents not less than ninety-five per cent. of a perfect stand.

If we go into our fields at husking time and make a study of the stand of corn, we will be convinced of the serious losses to ourselves and to the state each year from a poor stand of corn.

POOR SEED

"Poor seed" is more responsible for the "poor stand" and the "weak stalks" of corn than all other causes put together.

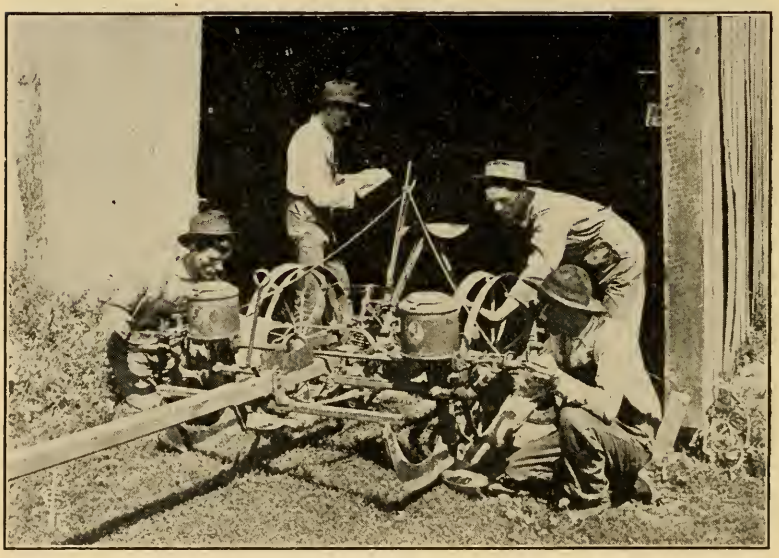

FIG. 11—Sixth Step.

After fifteen or twenty ears have been shelled and placed into the three grades, each grade should then be tested in the planter with the different sized plates. If these grades do not give satisfactory results in the planter, another fifteen or twenty ears should be shelled and more of the ears with the small kernels or with the large kernels put in the medium grade, as the case may require. After one or two tests of this kind have been made the remainder of the corn can be shelled and each ear placed in the grade in which it properly belongs.

During the past three years many thousand samples of seed corn have been sent to the experiment station at Ames to be tested. These samples came from every section of the state, and were made up in each case of two hundred kernels taken from one hundred ears, thus giving a representative of each man's

seed. These samples were given a careful germination test. This large number of tests shows that an average of seventeen per cent. was dead—that is, either the stem or root sprouts or both failed to grow—and that an additional nineteen per cent. was low in vitality and unfit to plant, leaving only sixty-four per cent. of good seed. It is also apparent that many of the kernels which give a fair germination are weakened, and in the event of a cold spring would either refuse to grow or give weak plants.

If every person in the corn belt could have seen the germination tests of these thousands of samples of corn it would not be necessary for me to appeal for the testing of six kernels from each ear of corn intended for seed.

Number of the Samples Received	Per Cent Giving Strong Germination	Per Cent Weak Germination	Per Cent Worthless
213	46	32	32
614	86	10	4
647	56	20	24
1556	70	28	2
1426	78	12	10
166	70	10	20
1055	64	24	12
91	40	40	20
1061	76	14	10
1067	60	16	24
1219	80	16	4
846	88	4	8
260	60	22	18
563	36	32	32
13	70	12	18
1127	80	20	0
326	66	14	20
410	52	10	38
733	80	6	14
388	64	14	22
1126	88	6	6
637	54	18	28
186	64	16	20
1099	84	12	4
590	52	14	34
1046	74	18	8
125	72	10	18
341	52	24	24
1022	50	16	34
632	92	8	0
Average....	66.8	16.27	16.93

The table on page twenty-one shows the test of thirty samples of corn, one sample being taken at random from each of thirty counties of Iowa. The average of these, as will be noticed, is a little above the average of the six thousand tests during the last three years, but it will bring out clearly the fact that poor seed does much to reduce the yield to one small ear per hill in the corn belt.

STRONG GERMINATION NECESSARY

It is quite generally supposed that if the seed sprouts in the spring it is all right. As a matter of fact much of it has

Fig. 12—Seventh Step. Picking Out the Black, Broken, Rotten Kernels—Kernels Which Will Take the Place of Good Kernels in the Planter Box and Then Leave Us Vacant Places in the Field.

often been so weakened that it will not grow, especially if the ground is cold or the seed is planted too deep, or if it does grow it gives only weak stalks, "fooling around all summer, doing nothing."

Let me beg of you not to fall back upon the statement which I hear so commonly—namely, "I never have any trouble with my seed corn." Quite as often I find that this man's seed is as poor as that of the man who was not so certain.

The fact is that bad seed costs the United States many millions of bushels of corn annually. Few people realize how great is this loss each year. We cannot afford to be careless with our seed corn—it means too much. Poor seed means a poor stand. Not only is a portion of our field idle, but we must cultivate the missing hills and the one-stalk hills and the poor, worthless stalks and receive nothing in return. Thousands of farmers in Iowa

Fig. 13—Receiving Samples of Seed Corn at Iowa State College Sent in by the Farmers for Testing.

During the past three years more than six thousand samples of seed corn have been received. Each sample consisted of two kernels from each of one hundred ears. Two tests of each sample were made. The average of all the samples showed that out of every one hundred kernels sixty-four kernels gave strong, vigorous germination—that is, were fit to plant; seventeen kernels had weak stem or root sprouts, or both, and were unfit to plant; nineteen kernels were worthless.

put in more than one-third of the time spent in their corn fields on ground that produces nothing.

THE GERMINATION TEST

There is no one thing which will do so much to increase the yield of corn on every farm as the making of a germination test of six or eight kernels from each ear of corn to be used for seed,

and *discarding* those ears which show *weak* or *sickly* root or stem sprouts. The most common mistake is to conclude that the seed is all right and does not need testing. Of two ears of corn planted in separate rows side by side, one may yield at the rate of more than eighty bushels and the other less than thirty bushels per acre.

Of two stalks in the same hill, both having exactly the same opportunities so far as soil, cultivation, etc., are concerned, one

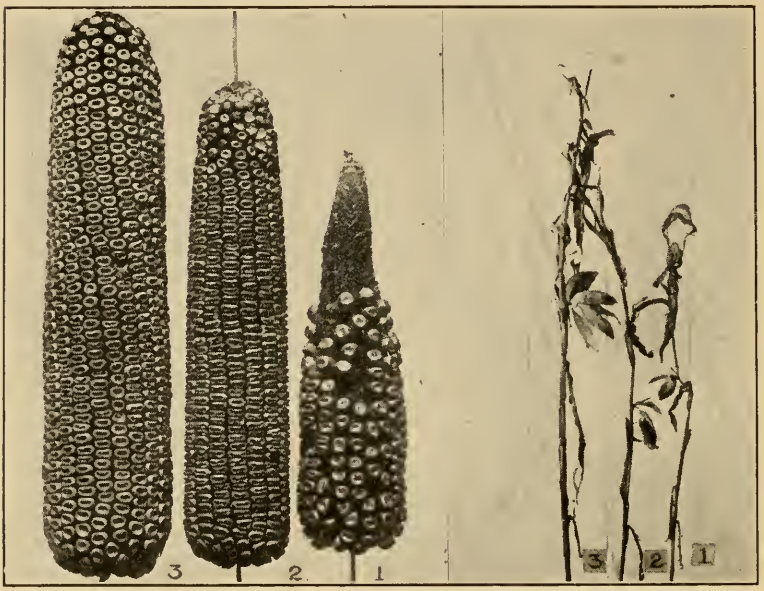

FIG. 14—The Product of a Single Hill of Corn.

The kernels which produced these three stalks came from three different ears. Practically the same difference was to be seen when the kernels sprouted, and a germination test would have enabled the farmer to throw out the ears from which Nos. 1 and 2 came. Every weak ear planted means from eight hundred to one thousand stalks like No. 1. It cost just as much to raise ear No. 1 as ear No. 3, but with what different results. If we discard those ears which show low vitality, we greatly reduce the number of barren stalks and those producing only nubbins and small ears. Stalk No. 1, which produced the worthless nubbin, had the same opportunity as stalk No. 3, which produced the large ear, except that they were from different ears of corn—that is, had different parents.

may produce a good ear of corn weighing a pound or more, while the other stalk will produce an almost worthless ear or none at all. The ear from which one of these kernels came was strong and vigorous and the other weak. The same difference which shows at harvest time between these two stalks also showed

when the kernels first began to sprout and grow in the spring. So it is that by testing a few kernels from each ear in the spring we may detect the weak ones and discard them.

One poor ear of corn discarded means not only the saving of waste land, but the saving of labor on nearly a thousand weak or worthless stalks. A few days spent during the month of March, when our time is otherwise of little value, in testing each ear of seed corn may be worth to us at harvest time more than a whole year's hard work. Let us remember, too, that we cannot injure our seed by testing it; we are running no risks; it costs but little time, and one person can put to test in one day enough to plant thirty acres.

The method here described may not be the best one, yet it has proved most satisfactory to us in testing the seed each year for more than three thousand acres, and it is followed by thousands of farmers in Iowa.

Fig. 15—Barren Stalks.

Of the five stalks in these two hills, only one produced a good ear. Note how sickly and weak the non-productive stalks are, compared with the productive one. Barrenness is one of the greatest sources of loss in corn growing. To the farmer who grows the corn for the grain alone these barren stalks are worse than a complete loss. They not only deprive the productive stalks of food, moisture and light, but they produce millions of grains of pollen, which are drifted over the field by the wind to fertilize the silks of the good stalks, and so reduce the vigor and future producing power of many of the good ears. Nubbins are simply a mild form of barrenness.

HOW TO MAKE THE GERMINATION TEST

Use a box four or five inches deep and about two by three feet in size. Fill

the box about half full of sawdust or moist earth, packed down firmly so that it will leave a smooth, even surface. In case

FIG. 16—Taking six kernels from each ear, and placing them on the floor at the end of the ear from which they were taken. Do not allow the kernels from one ear to become mixed with those from the ears lying next to it.

FIG. 17—Putting the kernels into the germination box, placing the six kernels from ear No. 1 in square No. 1, those from ear No. 2 in square No. 2, etc. One person can put over to test in a single day kernels from six hundred or seven hundred ears, or sufficient to plant thirty to forty acres.

sawdust is used (and I prefer it to anything else) it should be placed in a sack and set in a tub of warm water for half an hour

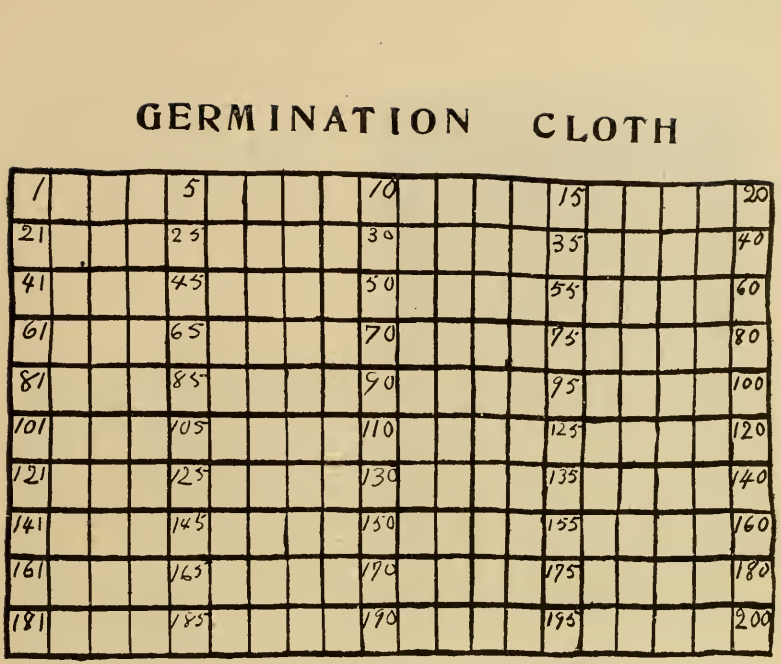

FIG. 18—A Piece of White Cloth Ruled Off into Squares Ready to Place on the Sawdust in the Germination Box.

The cloth should be tacked to the corners and edges of the box to hold it in place. This cloth is for a box twenty-eight by forty-eight inches in size, and will hold six kernels from each of two hundred different ears, or enough ordinarily to plant ten to twelve acres.

FIG. 19—This photograph shows the result of a germination test of six kernels from each of two hundred ears of seed corn. The six kernels from one hundred and forty of the two hundred ears gave a strong, vigorous germination, and were used for seed. The six kernels from twenty-six of the ears grew, but showed weakness, and were discarded as *unsafe*, while thirty-four of the ears were thrown out as *bad*, one or more kernels from each ear failing to grow. If these two hundred ears had been planted without testing kernels from each ear, there would have been sixteen thousand kernels that woud not have grown, or more than enough to plant one and one-half acres.

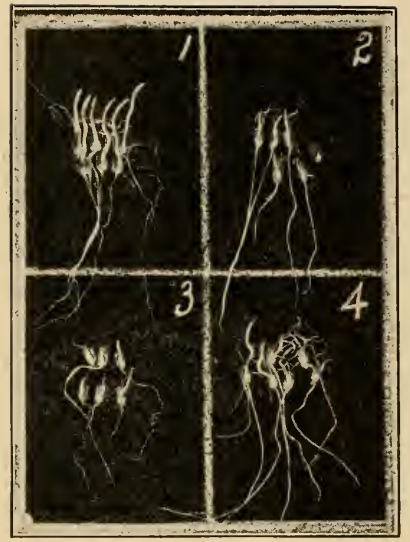

Fig. 20—The six kernels from ear No. 1 all have strong root and stem sprouts; those from ear No. 4 are only fair, while those from Nos. 2 and 3 are weak. It is such ears as Nos. 2 and 3 that we fail to discover when we depend on the eye and the jack-knife test.

so that it will be thoroughly moistened before using. Take a piece of white cloth about the size of the box, rule it off checker-board fashion one and one-half inches each way. Number the checks 1, 2, 3 and so on, and place it on the sawdust in the box and tack to the box in the corners and edges sufficiently to hold it to its place. Lay out the ears of corn to be tested side by side on the floor in rows, and drive two nails at the ends of the rows to hold the ears in place; remove one kernel from near the butt, middle and tip of the

Fig. 21—The weak and worthless kernels separated from the strong and placed on the right. Of the twenty-five kernels tested from this man's corn, sixteen were strong, four weak and five bad; or on the basis of one hundred, sixty-four per cent. were strong, sixteen per cent weak and twenty per cent worthless. This is almost exactly the average of the six thousand samples sent in for testing during the past three years.

ear; turn the ear over, and remove three kernels from the opposite side in like manner, making six kernels in all, thus securing a representative sample from the entire ear. Place the six kernels at the end of the ear from which they were taken. Use care that the kernels do not become mixed with the kernels from the ear next to it. After the kernels are removed boards may be laid over the rows of corn to keep the ears in place until

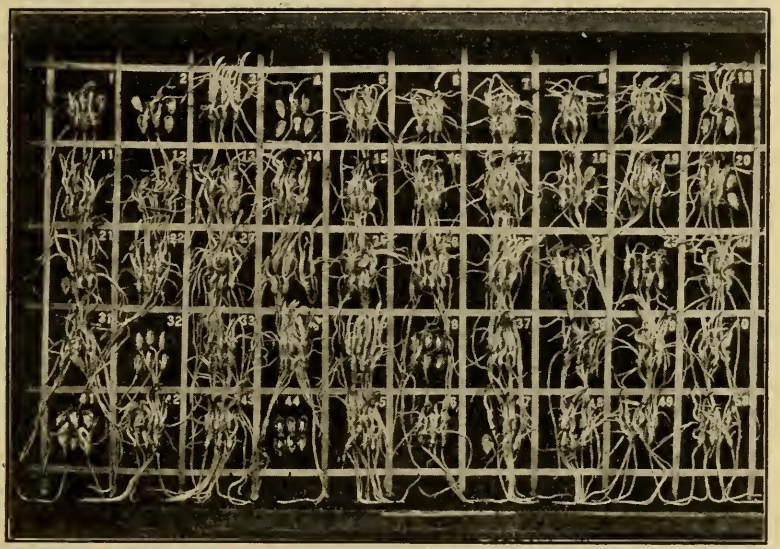

FIG. 22—Germination box nine days after the kernels were put over to test. The stem sprouts are about two inches long on the most vigorous kernels. It is now easy to distinguish the weak, sickly and slow sprouts from the strong and vigorous ones. Study the germination box carefully. Two hours spent discarding the weak ears as shown by the sprouts of the six kernels from each ear will save hundreds and hundreds of missing hills, one-stalk hills and weak stalks producing little or nothing next summer. More than this, it is also the best method of breeding or improving our corn, as we prevent the weak ears from reproducing themselves.

The six kernels from ear 44 all failed to grow. One or more of the kernels from ears 1, 2, 4, 10, 18, 20, 21, 36, 41, and 47 failed to grow. These ears should be discarded. Ears 32, 46 and 29 are illustrations of weak ears. Do not fail to throw out all such as these. If the conditions are unfavorable they will fail to grow, or, growing, will produce only weak stalks, bearing nothing, or only small, inferior ears. Nos. 3, 34, 35 and 45 are especially vigorous, and will give a good stand of ear-producing stalks.

the germination is known. Place the kernels from ear of corn No. 1 in square No. 1 of the germination box, from ear No. 2 in square No. 2, and so on with the kernels from all of the ears; then place over this a cloth considerably larger than the box, cover with about two inches of moist sand, dirt or sawdust, and keep in a warm place where it will not freeze. There

is no place in the house too good for this germinating box.

In about eight or nine days, when the stem sprouts from the most vigorous kernels are about two or three inches long, the covering should be removed, care being taken not to misplace the kernels. (A piece of cloth spread over the kernels before the covering is put on will prevent the kernels from sticking

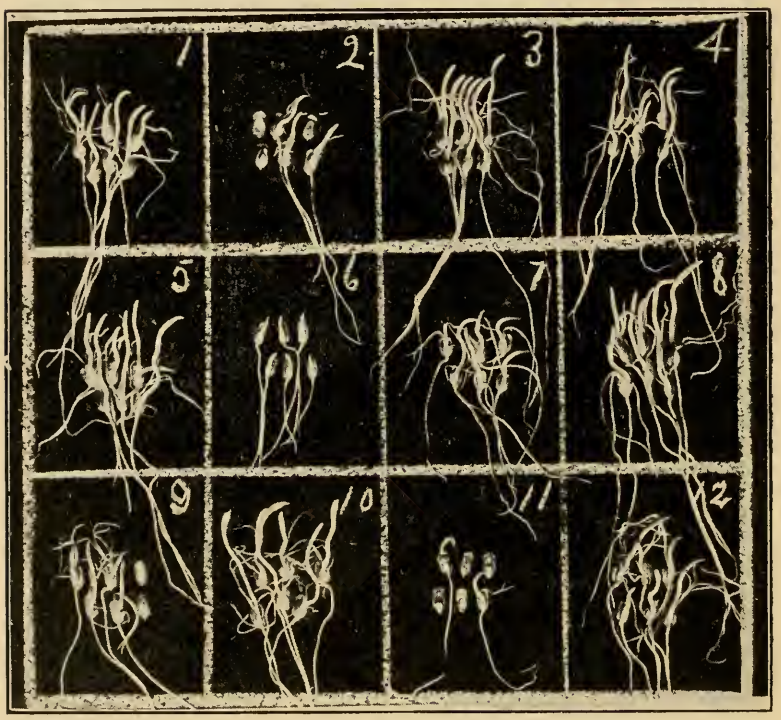

FIG. 23—Do not "guess' that the eight hundred kernels from an ear will all grow and produce strong plants. For less than ten cents per acre six kernels from each ear may be tested, and this allows two dollars per day for labor and twenty-five cents for the germination box. The missing hills and weak stalks in our fields are largely due to seed from ears like Nos. 2, 6, 7, 9 and 11. The weak stalks are shaded by the strong ones, and become relatively poorer as the summer advances.

to the upper cover.) Now make a thorough study of the six kernels in each square in the germinating box, and carefully note those which either failed to grow or are weak, showing low vitality.

For example, the six kernels in square No. 44 failed to grow; one or more of the kernels from ears Nos. 1, 2, 4, 10, 18, 20, 21,

33, 41 and 47 failed to grow. These ears should be discarded. Ears 32, 46, and 29 are illustrations of weak ears. Do not fail to throw out all such as these. If the conditions are unfavorable they will fail to grow, or, growing, will produce only weak stalks, bearing nothing or only small, inferior ears. Nos. 3, 34, 35 and 45 are especially vigorous, and will give a good stand of ear-producing stalks.

But this does not, by any means, measure the damage done by these inferior stalks. They produce millions of grains of pollen to drift over the field to fertilize the silks of ears on vigorous stalks, thus continuing their worthlessness from generation to generation.

If six kernels from every ear intended for planting on every farm in the United States were tested in a germination box in March and all the weak ones discarded, it would add hundreds of millions of bushels to the corn crop of the United States annually.

There is no one thing that costs so little and would add so much to the profits of every farmer. There is no good reason why every ear should

Fig. 24—Samples of Seed Corn Sent in by Two Different Farmers.

In 1906 more than sixteen hundred samples of corn were sent in for germination tests by the farmers of the state. Two tests of twenty-five kernels each were made of each man's corn; in many cases three tests were made. These two samples (632 and 735) were put over to test side by side at the same time. Notice the great difference in the strength and vigor of both stem and root sprouts. Twenty-three of the twenty-five kernels from farmer No. 632 were very strong and only two were weak. Only fifteen of the twenty-five kernels from farmer No. 735 gave strong sprouts, three were weak and seven were worthless. On the basis of one hundred kernels the tests are: Sample 623, ninety-two per cent. strong, eight per cent weak, none worthess; sample 735, sixty per cent. strong, twelve per cent. weak and twenty-eight per cent worthless. Sample 735 is characteristic of hundreds of others, many of them much poorer than this. Seed like this does more than anything else to reduce the average yield to one small ear per hill.

Fig. 25—By testing six kernels from each ear we are able to detect the weak and worthless ears. No. 1 shows weak germination. In No. 3 three of the kernels sent out weak stem sprouts, and none of them sent out main roots. No. 2 is a good example of vigorous germination. Ears Nos. 1 and 3 should be thrown out. An ordinary examination of ear No. 1 would not reveal the weakness shown so plainly in the germination box. We cannot afford to plant ears like No. 1; it means eight hundred or one thousand weak stalks at best.

FIG. 26—Three Stalks in One Hill from Three Different Ears.

These kernels all had the same opportunity except that they were from three different ears—had different parents. Anyone who will study a dozen corn fields in his vicinity will be convinced of the tremendous losses from missing stalks and from those that are weak or entirely worthless.

FIG. 27—These Two Hills are From Two Different Ears of Corn.

The hill at the left is from an ear whose kernels, when tested in the germination box, showed rather weak stem and root sprouts. Note the difference in the root systems of these two plants.

not be tested. You cannot injure the corn by testing six kernels from each ear before shelling it. It costs nothing but a little time, of which there is plenty at the season when it should be done. One man can be put over to test enough for thirty acres in one day. If $1.75 were charged per day, for all the work it would cost less than ten cents per acre; yet because it is "too much bother" we will *guess* that the eight hundred kernels on the ear are strong and vigorous. On hundreds of farms in Iowa last spring the boys and girls laid out the ears, removed the kernels, prepared the germination box, put the kernels in the squares, and later helped in examining the sprouted corn and discarding the ears that showed the weak sprouts.

Weak seed means missing hills, one-stalk hills and weak and barren stalks; it means twenty-five bushels per acre for the United States instead of fifty bushels; it means wasted labor and wasted land. We have tested the seed for thousands of acres each year, and I realize how much it

means to every farmer. Try it; and do not put it off until the rush of spring work is upon you, or it will be neglected. It requires quite an effort to do a new thing.

Mother earth may offer her choicest cradle, the sun may lavish his brightest rays, the gentle showers may float down upon the balmiest winds of spring to nourish the infant plant—yet, if this child of the First Great Cause has been touched by the blighting breath of decay, or is the offspring of perverted parentage, all the kindly care of loving Nature, aided by the hand of man, only emphasizes more strongly that "Whatsoever a man soweth, that shall he also reap."—From Farmer's Tribune.

GRADING THE SEED AND TESTING THE PLANTER

After the seed ears have been selected, from the general appearance of the ear and kernels and for their germinating qualities, they are ready to be graded for the planter. The ears should first be butted and tipped. This is done for two reasons. In the first place, butt and tip kernels produce less than middle kernels, and in the

FIG. 28—Four Stalks in One Hill.
Two are from ears which showed strong germination test; the two at the right are from ears which showed weakness in the germination box.

FIG 29—This hill of three vigorous stalks is from three different ears, each of which showed a strong vitality when tested in the germination box.

second place they are so irregular in size and shape that the planter cannot drop them evenly.

SHELL EACH EAR SEPARATELY

Each ear should be shelled by itself, as this gives an op-

Fig. 30—One Hundred Individual Ears Each Planted in a Separate Row.

These ears were all good seed ears, so far as could be determined by the eye aided by the jack-knife. Row "*a*" is particularly strong, while "*b*," the row next to it on the left, is weak; row "*c*," the next on the left, has a thin stand, nearly half of the kernels failing to come. Several of the ears in this field produced at the rate of over ninety bushels per acre, while others yielded less than thirty-five bushels. Had six or eight kernels from each ear been tested and the twenty poorest ears discarded before planting, the average yield would have been increased four bushels per acre, or four hundred bushels on a one-hundred-acre field of corn, or an increase of $140.00 at no additional expense except a few hours' labor in testing the seed.

Fig. 31—The plot on the right is from an ear which gave strong, vigorous sprouts in the germination box, while the plot on the left is from an ear which showed poor germinaton in the test. Anyone who will test six kernels from each of one hundred ears, and then plant the corn from each of these ears in separate blocks in the field and harvest each separately, will realize the importance of discarding the ears which showed weakness in the germination box.

portunity to discard ears with broken or injured kernels not discovered in previous examinations. It also gives an opportunity to grade the kernels into large, medium and small sizes. This will make it possible for the planter to drop the required number of kernels in each hill.

In grading a large quantity of corn frequently five or six grades can profitably be made. Even in a few bushels of well-selected corn we are likely to find ears with broad, thin kernels, broad, thick kernels, long, narrow, shoe-peg kernels, and perhaps one or two other distinct types. In shelling, one man can turn the sheller and put the ears in, a second man can catch each ear by itself in a large, shallow pan as it comes through, and after a little practice can tell at a glance to which grade it belongs. Have a box for each grade. While these kernels differ widely in shape they are all good. They possess strong vitality, as shown by the germination test, and will in all probability produce vigorous ear-producing stalks. Still it would not be good practice to shell them together, as the planter could not successfully handle kernels of such widely different types.

Fig. 32—Three stalks from a single hill. Stalk No. 3 is barren, but it produced millions of grains of pollen to fertilize the ears on neighboring stalks, and thus the tendency to barrenness is increased.

TESTING THE PLANTER

When about twenty or thirty ears have been shelled and graded, the grades should be tested in the planter, with the different plates, and in this way the grades may be adapted as far as possible to the plates on hand.

HAND-PICKING THE SEED PROFITABLE

The corn should now be spread out thin on the table, one or two quarts at a time, and hand picked, removing all the black, broken, rotten and inferior kernels of every kind. This work

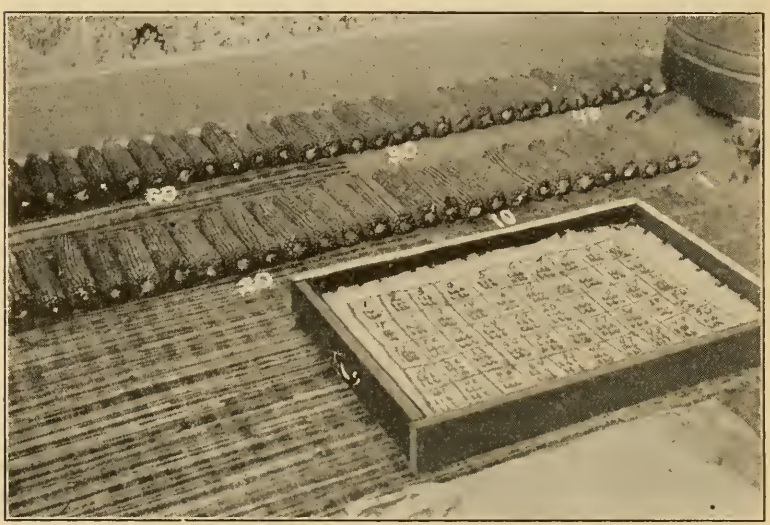

FIG 33—Six Kernels from Each Ear Placed in the Germination Box Ready for the Covering.

This man laid the ears out in rows on the floor in an upstairs room. A nail was driven into the floor lightly at the ends of the rows, and also after every tenth ear, to hold the ears in place.

can generally be done to the best advantage in the evening, after supper, when the boys and girls are home from school to help.

When the corn has been properly graded and hand picked, as described above, it should be placed in sacks (not more than one-third of a bushel in each) and hung up in a dry and well-ventilated place, such as the attic, until planting time. Do not hang over the laundry room nor over the stable. If the sacks

are suspended by short wires hung to other wires stretched through near the ceiling there will be little danger from mice.

SAVE THE CHOICEST EARS FOR SEED

When selecting and testing our seed we should save out one hundred or more of the choicest ears—those which not only please us in appearance of ear and kernel, but also give a strong test in the germination box. The corn from these ears should be placed in a separate sack, and in the spring it should be planted in one of our best and earliest planted fields. It is from this

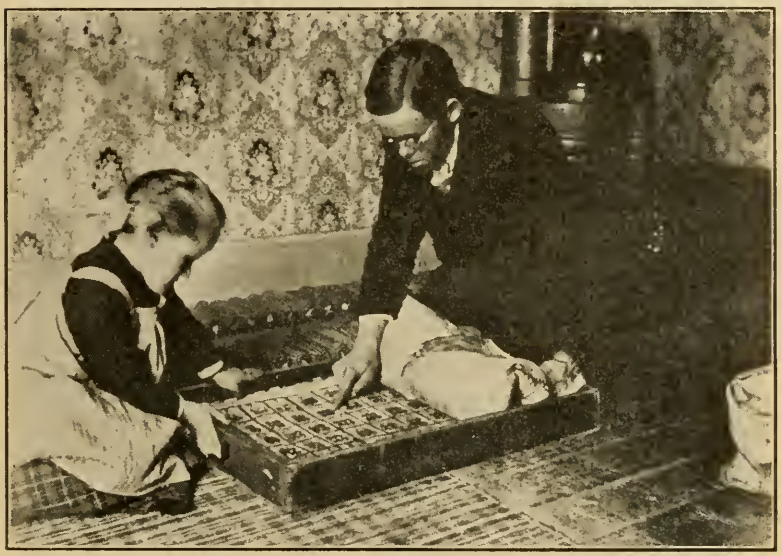

FIG. 34—Examining the Germination Box to Discover the Worthless Ears.
Hundreds of Iowa boys and girls tested the seed corn for the crop of this year. The young people in this case got too anxious, and will have to wait a few days until the germination is further advanced and the sprouts have grown two or three inches long.

field that our seed should be selected next fall; for there is no law more certain than that "like tends to produce like."

Whether our land be rich or poor, whether it be well or poorly prepared, whether the care of the crop be good or bad, whether or not the insects levy tribute on the crop, whether or not the season be favorable, yet our chances for a crop are *better* if we have *good seed*, seed that will not only grow, but that will produce strong, vigorous stalks with good ears.

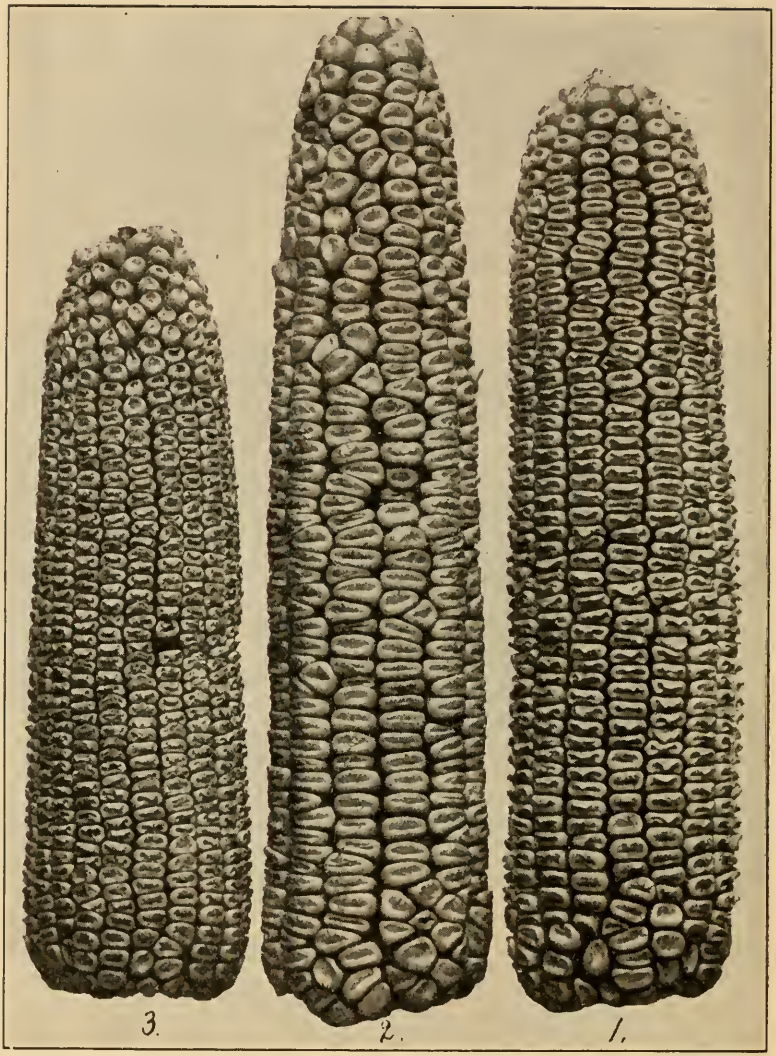

Fig. 35—Uniformity in Size and Shape of Kernels.

Seed corn should be graded by shelling each ear separately and placing in the grade to which it belongs. Ear No. 2 has five hundred and forty broad, thick, shallow kernels. Ear. No. 3 has eight hundred and ninety long, narrow kernels of the shoe peg type. The planter cannot be adjusted so as to drop a regular number of kernels per hill unless there is uniformity in both size and shape of kernels. Each ear of seed corn should be shelled separately, and the kernels put into either the large, medium or small grade to which they correspond most nearly in size and shape. When fifteen or twenty ears have been shelled and separated into three grades in this way, each grade should be put in the planter box and tested by making one hundred or more drops with the different planter plates to determine the accuracy of drop.

CHAPTER III

COMBATING CORN PESTS

Rotation of crops is the most practical and powerful means of combating the insect enemies of corn. The losses each year are something enormous. Hundreds of samples of insects and injured specimens of corn are sent to the agricultural college annually with a request for a remedy.

When the enemies have taken possession of our corn fields, there is no immediate remedy. The insects will take the corn in spite of us and we must pay the penalty. We are, in most cases, simply reaping the perfectly natural consequences of our own or of our neighbors' bad methods of the past.

It is most fortunate, indeed, that that system of rotation of farming which will give the most profitable return from each acre and from each day's labor under normal conditions in the Central West, even if there were no insect enemies, is also the system which will most successfully combat these insect enemies.

CONTINUOUS CROPPING VICIOUS

Continuous cropping with the same crop is vicious. It means dependence upon the success of one crop and lack of distribution of labor. It means a poor soil and a poor physical condition of that soil and consequently poor crops and favorable conditions for the development of the insect and fungous enemies peculiar to the crop.

Having made a careful study of the conditions of hundreds of corn fields throughout the corn belt both last year and this, it is very apparent: *First*, that little or no damage is being done to the corn crop from insect enemies where the farmer practiced a good system of rotation of crops, and this is especially true if his neighbor also had an equally good system of rotation; *second*, that the reverse is almost invariably true; *third*, that corn continuously on the same ground is practically always seriously damaged by the corn root worm, and generally by the

corn root louse also; *fourth*, that meadow ground is left down for

Fig. 36—Effect of the Corn Root Worm.

Nos. 1, 2 and 3 were from field badly injured by root worm. The field yielded twenty bushels per acre.

No. 4 is from an adjoining field not affected and yielded sixty bushels per acre.

The root worm destroys the corn roots and the stalks are deprived of moisture and food and fall down badly during the wind storms, especially after heavy rains when the ground is soft. See Nos. 2 and 3.

In the case of No. 3, the brace roots have taken root and are making up somewhat for the loss of its feeding roots.

The remedy is rotation of crops. The corn root worm, so far as known, lives only on the roots of the corn plant "and possibly sorghum." The eggs are always laid in the corn field by the beetles and the first crop of corn is not damaged by the worm. The second crop consecutively on the ground is apt to be considerably affected, especially in a region where corn is extensively grown. This is owing to the fact that the beetles fly from one corn field to another and deposit their eggs. If this latter field is not planted with corn the following season, there is no food for the worm and it dies.

Many hundred fields of corn have been examined during the past four years, and in almost every case where corn has been grown more than two years continuously, the damage has been very marked, amounting to thirty or more bushels per acre.

where pasture and especially several years, it becomes the breeding place for white grubs, bill bugs, stalk borers, cut worms, wire worms, army worms, root web worms, etc., which frequently do great damage to the following first and second corn crops; *fifth*, that there is almost never any damage where the rotation was corn one year, oats one year, and seeded to clover one year, followed again by corn. But where the second crop of corn is put on the same field continuously it is generally seriously damaged, especially where the nearby neighbors on the south and west have cropped their fields in corn continuously. The beetles naturally migrate with the wind to the fields on the north and east where they lay their eggs to hatch the following spring.

MEADOWS ARE LEFT DOWN TOO LONG

Where the meadow and pasture lands have been down for several years, and have become badly infected, the loss to the meadow itself is a serious matter, though not so noticeable as in the case of the first and second crops of corn which follow.

It is a common thing to find the grass in old meadows and pastures so weakened in large spots by the grub, wire worms, cut worms, and web worms that the wild barley or squirrel tail and other weeds come in and take partial or even entire possession of the ground. The presence of the squirrel tail is generally the direct result of some or all of these insects. Frequently the squirrel tail will be found in irregular patches along the sides of the meadows and pastures. This is due to the weakening of the grass by grubs, cut worms, etc., which have worked into the fields from the hedgerows, which too often become the breeding ground of our worst enemies.

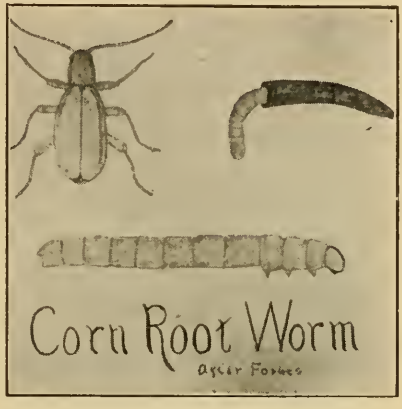

Fig. 37—Corn-Root Worm.

No. 1 shows the worm much enlarged; No. 2, the beetle which lays the eggs; No. 3, root broken off, showing worm at work.

The root worm is a small white worm about one-half inch in length and about as large as a pin. When the worms are full grown they leave the roots and pupate or transform into a beetle about twice as large as the head of a pin. They then come out of the ground and feed mostly on the silks of the ears of corn. When they first appear they are a pale yellow, but turn to a grass-green color in a few hours. The eggs are laid in the ground by the beetles near the stalks of corn during August and the first part of September, and hatch the following summer, during the latter part of June and the first of July, when the worm enters the corn roots and begins the work of destruction.

PUT CLOVER IN THE ROTATION

Every rotation in the corn belt should have clover in it. A rotation without clover is hardly worthy the name. The insects which work on the leguminous crops, such as clover, are not the ones which generally damage the grasses and corn crops. It is a rare thing to find any serious damage to the corn crop following the first or second year of clover. Where damage has occurred to corn following clover, it has generally developed that the field has been down more than two years and that it was not in reality a clover field. It *had* been once, but the clover had given way to timothy and other grasses.

FALL PLOWING BEST FOR OLD SOD

Fall plowing is generally good practice. It distributes labor, insures against too late planting, makes it possible to

secure a better preparation of the ground, gives a better stand of corn, destroys some of the insects and lessens the effect of those not destroyed through a more vigorous growth of corn.

The white grub and wire worms are frequently worse on second sod.

This is due to the fact that there is generally some grass left in the field the first year upon which the insect subsists, but by the second year it is entirely killed out and they have only corn to depend on.

FIG. 38—Field Fifteen Years in Corn Continuously.

The field had been manured for this crop. The damage from the root worm was so great that hardly a stalk was left standing upright and the yield was less than fifteen bushels per acre of corn of a very inferior quality, many of the ears being light and chaffy, while others were rotted and entirely worthless from lying on the ground.

The white grub and the wire worm remain in the ground two or more years before changing into beetles, the former becoming the June bug or May beetle, the latter being known as the clicking or snapping beetle. The cut worm lives but one year and does its chief damage on the first year's sod corn and especially on spring plowing.

CORN ROOT LOUSE OR APHIS

Next to the corn root worm, the corn root louse probably causes more loss each year to the corn crop than any other insect pest. The lice are smaller than the head of a pin, blue-green in color and appear in clusters on the roots of the corn. They are always found associated with ants, which act as guardians, protecting them and carrying them to the roots of the corn. The lice pierce the root covering with the sharp beak and suck the juices which should go to build up the plant. When disturbed by the ants they exude a sweetish substance from the two honey tubes called "honey dew" upon which the ants feed.

The root louse does its greatest damage on "old, badly worn" fields, especially if they have been in corn for several years. It is always worse on the low, damp ground, because of the fact that the ants transfer the lice to the roots of the smartweed and foxtail during the latter part of the season when the corn roots have become hard and woody.

It is difficult to keep the low, wet places free from weeds, and, hence, they become the breeding places of the root lice and ants.

The greatest damage is done when the corn is small. The lice often attack the root as soon as the corn sprouts and kill it before it comes up. The plant generally lives, however, but makes a slow, feeble growth.

The indications of lice are: *First:* the presence of ants in the field with ant holes in the hills of corn, often made before the corn comes up; *second*, a slow growth of the corn in spots through the field, when it is small, the corn having a sickly, yellow appearance. Where they are particularly bad, the corn will have a purple tinge, toward the tips of the leaves, the stems or stalks will have a reddish color; *third*, the corn is held back so that it matures late in the fall, often being caught by the frost; *fourth*, the yield is greatly reduced and the quality of the corn is poor.

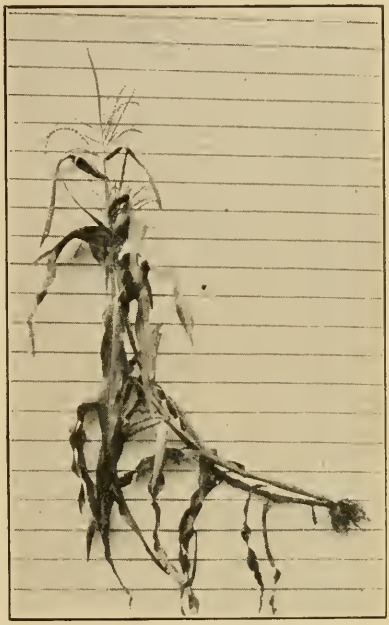

FIG. 39—Hill of Corn Badly Injured by the Corn Root Worm.

Nearly all the roots were destroyed, and the corn went down during the latter part of July. In attempting to recover, the stalk bends upward, giving the appearance shown in the picture. In case the corn goes down during the latter part of August, after it has made its full growth, it will lie flat on the ground and not recover. Note the very poor ears of corn on these stalks. The supply of moisture and plant food was cut off by the root worms, consequently the ears were poorly developed, and when husked the corn was chaffy and light.

REMEDY

The remedy is: *First*, rotation of crops; *second*, clean cul-

FIG. 40—Two corn roots taken from different fields. The root at the left, marked No. 2, is from a field badly damaged by the corn root worm. The field had been in corn continuously for three yeras. The root at the right, No. 1, is from a field which was in oats the previous year, and consequently was not injured by the corn root worm. The roots on No. 2 were so badly destroyed that the stalk was easily lifted out of the ground with one hand, while it required considerable effort to pull No. 1, and the lower leaves were not fired as were those on stalk No. 2.

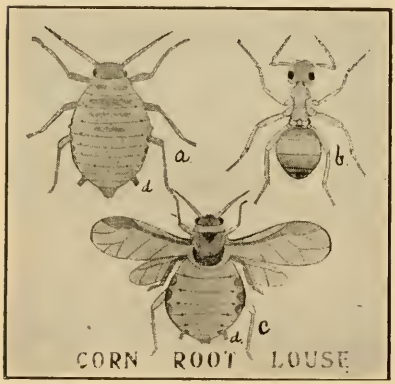

FIG. 41—Corn-Root Louse, or Aphis. *a*, Louse; *b*, Ant which Acts as a Guardian; *c*, Winged Louse; *d*, Honey Tubes.

The lice are considerably smaller than the head of a pin, bluish-green in color, appearing in clusters on the roots of the corn early in the spring. They are always found associated with ants which act as guardians, protecting them and carrying them to the roots of the corn. When disturbed by the ants they exude from the honey tubes a sweetish substance called honey dew, on which the ants feed.

REMEDY—Rotation of crops, harrowing before the corn comes up and frequent cultivation after it it up, to disturb the work of the ants and to warm the ground and hasten the growth of the corn.

tivation in low places; *third*, harrowing or cultivating the ground before the corn comes up and when the corn is small. This hinders the ants in transferring the lice and their eggs to the roots of the corn and also stimulates the corn to more rapid growth. *Fourth*, manuring the ground. This gives a vigorous growth and enables the corn to better withstand the drain by the lice.

THE CORN ROOT WORM.

Its damage is estimated at 200,000,000 bushels annually in the corn belt.

Owing to the serious losses caused by this pest everywhere in the corn belt, I wish to emphasize the remedies.

Next to poor seed corn, the "corn root worm" is the greatest source of loss to the corn crop. The loss varies in different fields from a few bushels per acre to the destruction of nearly the entire crop. The work of the corn root worm is not limited to any particular section, but is general throughout the corn belt. Of the six hundred fields examined this season and last in Iowa, Illinois, Kansas and Missouri, more than four hundred were more

or less injured by the worm. has damaged the crops this year and last in Iowa alone to the extent of three bushels per acre, or 28,000,000 bushels, is placing the estimate at the lowest possible figure. If the actual damage could be determined, it would probably be double this amount. The root worm is so very small and does its work down under the ground in the roots of the corn, unobserved, and does its work so gradually that few people have any knowledge of the insect or the losses sustained annually.

The eggs are laid mostly during August and September and hatch the following spring in June and the first part of July. When full grown, the worm is about one-third of an inch in length and as large around as a pin. As soon as hatched, the worm enters the roots of the corn, and burrows back and forth, lengthwise, through the root, just under the outside covering. Sometimes five or six worms will be found in one root and more than two hundred have been found in a single hill. The roots thus affected finally die and rot off, leaving short

To say that the corn root worm

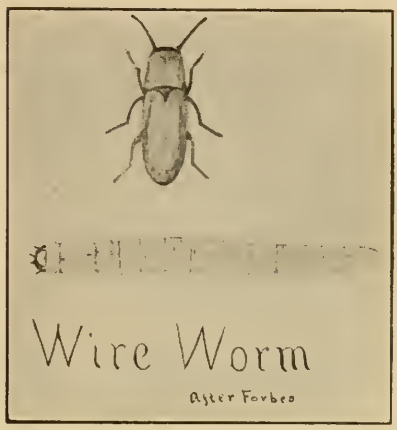

FIG. 42—Wire Worm.

The wire worm often does its greatest damage on second-sod corn and on the knolls or slopes, and also in the low places where the ground has been tiled out and recently put under cultivation. The worm often eats through the kernels of corn and the small plants, killing the plants before they come up. They also feed on the roots of corn and bore holes through the stalks below the ground, doing much damage throughout the entire season.

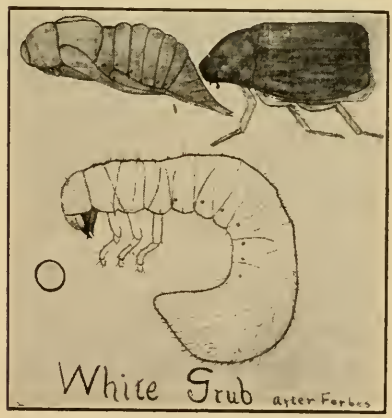

FIG. 43—White Grub.

The above cut illustrates the white grub which frequently destroys the corn on old sod ground. Two or three grubs will often be found in a single hill, living on the roots of the corn.

stubs. The stalk of corn is thus deprived of moisture and nourishment and after a rain when the ground is soft, and especially with a heavy wind, the corn often goes down badly, particularly in those places most affected.

Generally the worm will have reached its full size the latter part of July and first of August, when it pupates and in a few days comes out as a small beetle, light or yellowish green color at first, but soon turns to a grass-green color. It distributes itself throughout the field and migrates to other fields of corn,

Fig. 44—This field has been in pasture for several years, and is badly infected with the white grub. The hogs have torn the sod up completely, rooting for grubs and other insects. Fields left down to pasture or meadow for a number of years are almost certain to become badly infected with grubs, wire worms, cut worms, bill bugs, etc., and, consequently, when this ground is finally put in corn the first and second crops are both seriously injured, and if continued in corn the third and fourth crops will be even more seriously damaged by the corn root worm.

feeding on the silks, and the corn at the tips of the ears, especially where the husks have been broken open and the corn injured by the birds, ear worms, etc.

So far as known in the North, the corn root worm works only on the roots of corn, and it is almost certain that the eggs are always laid in the corn field.

Several hundred fields of corn were examined during this and last summer, but in no case did I find any damage from the root worm where corn followed some other crop, as pasture,

clover, oats, wheat, etc. The second crop of corn was damaged considerably, except in a few sections where corn is not the principal crop. But where corn has been grown more than two years on the same ground, consecutively, the damage was always serious, and in many cases the yield was reduced to fifteen or twenty bushels to the acre, and this, too, in some instances where the ground had been manured in the winter before the plowing in the spring.

FIG. 45—Corn Ear Worm, Sometimes Also Called the "Cotton Boll Worm," or Tobacco "Bud Worm," etc.

Everyone is familiar with the work of the corn ear worm. This worm is found distributed throughout the United States. The greatest damage has been done in the South, where it works on corn, cotton, tobacco, beans and other plants. The damage has been unusually great during the past year throughout the corn belt. The worm is especially fond of sweet corn, and injured the corn to such an extent that several canning factories were obliged to shut down. There are from three to five broods each year. They pass the winter in the pupa stage in the ground, and come out in the spring as moths to lay their eggs. The first brood eats the leaves of corn and other plants, the second brood eats the silk and tassels, and the third brood eats into the end of the ear of corn, and works back and forth. The actual damage done by the ear worm itself is not so great as the injury resulting from other insects, mold, rot, etc., which follow up the work of the worm. There is no known remedy which is successful. In the South it is claimed that fall plowing of the badly infested corn ground exposes the pupa to the freezing weather, killing many of them

INDICATIONS

First: The corn will have an uneven appearance, certain patches being especially poor and making a slow growth during the latter part of June and first part of July. The corn will have a yellow or sickly appearance and seem to stand "still."

Second: The presence of the worm itself, which can be determined by pulling up a hill of corn and breaking open the roots.

Third: The appearance of the roots. When one root has been destroyed, the worm attacks another. Often every principal root and the brace roots are completely destroyed, while in fields not so badly affected only a portion of the roots are destroyed;

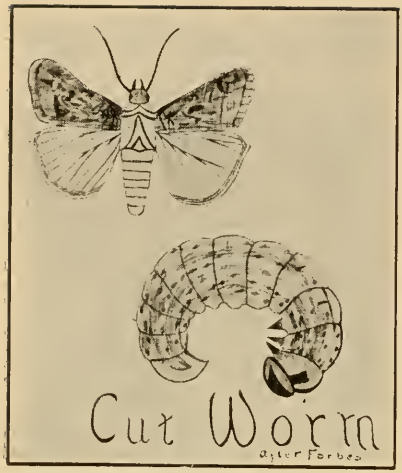

FIG. 46—Cut Worm.

a, larva; *b*, moth.

The greatest damage done by the cut worm is on the first-sod corn, especially where the field has been down to meadow or pasture for a number of years. Remedy is late fall plowing; shorter rotation, using clover and leaving down but one or two years.

FIG. 47—Stalk Borer.

a, adult; *b*, larva; *c*, larva in oat stalk; *d*, pupa.

Sometimes called the "heart worm," because it eats into the center of young corn plants, frequently destroying the plant. The damage is generally mostly confined to the two or three outside rows next to the hedge rows or meadows. It often injures oats, the heads turning yellow prematurely, due to worms working up and down through the stalks, eating through the joints.

other roots will have a dark appearance and, when split open, show the burrows of the worm, although the worm may have left the root some time before.

Fourth: The falling down of the corn during the latter part of July and August, especially in the spot most affected and after a rain followed by a wind; later the stalks will curve upward, giving a sled-runner or rainbow appearance to the stalks.

Fifth: Ease with which the stalks may be lifted out of the ground, even with one hand. It will require considerable effort to pull up a healthy hill of corn with both hands.

Sixth: The firing of the corn during the dry weather of July and August.

Seventh: The large number of stalks in the field with no ears and with very poor ones.

Eighth: The presence in the corn field, especially in the silks at the tips of the ears, during August and September, of a large number of small green beetles, about twice as large as the head of a pin. They are most numerous during Au-

gust, although they may be seen as late as October in the late planted field.

Ninth: The corn is often retarded in growth and matures late and is often injured by frost as a consequence. Where the corn falls down badly, it rots before husking time.

Tenth: The corn is light and chaffy and often moldy.

REMEDY

The remedy is rotation of crops, never growing more than two crops of corn continuously on the same ground.

If the corn went down considerably in August, especially in spots, if the stalks can be pulled up readily and the roots are badly rotted off, if there are many barren stalks or stalks with poor ears, and if the field has been in corn two years consecutively, it should go into some other crop for at least one year, and better, if it is seeded down and left one or two years in clover.

FIG. 48—Corn Bill Bug.

Recently considerable damage has been done in some sections of the corn belt by the corn bill bug. Sometimes whole fields have been entirely destroyed. The most serious complaints have been from corn on the first or second sod. The damage is generally confined to the outside two or three rows in the field. Where a regular system of rotation is practiced and the field is not left down to grass more than two years at a time, there is seldom much damage except to the outside rows near the fence row or grass border. The bill bug does its work when the plants are small. No. 1, the stalk on the left, shows the position of the bill bug when at work. He thrusts his long snout into the young plant and eats the tender corn. If the bill bug does not kill the plant (and generally it does not) there will appear rows of holes in the leaves weeks later as it develops (see stalk on right in cut). These holes are made by a single thrust of the snout into the small plant before the leaves were unfolded. Nos. 3 and 4 show the beetle much enlarged.

The damage to the corn crop annually by the corn root worm in the corn belt is enormous. Rotation of crops is the only remedy and now is the time to decide what to do with the field next year.

FIG. 49—Corn and Stock Judging Pavilion, Iowa State College.

"The farmer who adopts better methods this year is not only a better farmer himself in the future, but his methods, directly or indirectly, soon become the methods of the community."

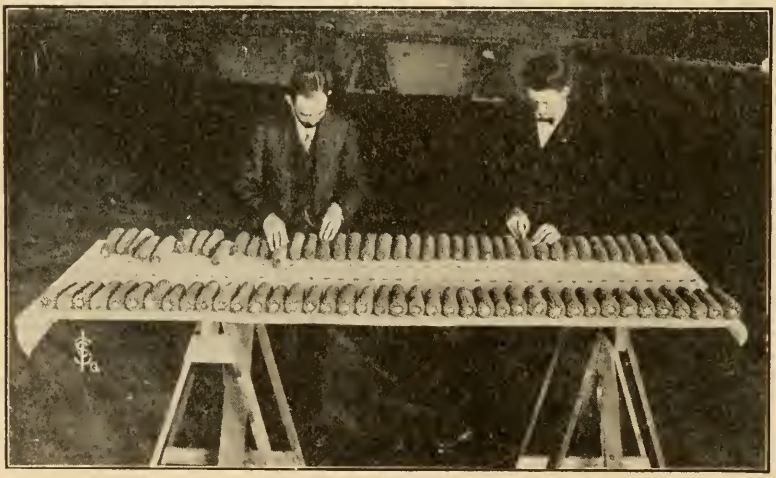

FIG. 50—Discarding Poor Ears.

Before making the germination test, the seed ears should be laid out on some board or planks where they can be studied, and with an ear of desirable type in one hand, the corn should be gone over carefully and all ears which do not conform to this type in size, color, shape of both ear and kernels, should be thrown out. We are now ready for the germination test.

CHAPTER IV

HARVESTING AND STORING SEED CORN

"If every ear of corn intended for planting next spring was harvested this fall not later than the middle of October and hung up in the attic, where it could dry out thoroughly before the bitter cold freezes of November and December, millions of dollars would be added to the value of next year's corn crop."

While there are many who exercise great care in the harvesting and storing of their seed corn, yet we must all agree that the majority have become extremely careless, often depending upon the occasional good ears found throughout the entire husking season for seed, and, in thousands of cases, the seed is simply selected for planting in the spring from the crib. There must be a tremendous "jogging" or waking up to the importance of better care of the seed corn in the central west.

We have "Arbor Day." Would it not also be well to have a "Seed Corn Harvest Day" in each state—a day when everyone should begin the harvesting and storing of his seed for the following spring? We laugh at our grandfathers for planting their potatoes and sowing their grain "in the moon," that is, in certain phases of the moon. The value of this practice lay, not in the fact, as supposed by many, that the moon exercised any influence on the crop, but in the *having* of a *definite time* and *plan* for the *doing* of various things on the farm.

If the harvesting of seed corn, like the feeding of stock, came every day, it would be attended to on time, but it is nothing more nor less than human that the work which comes only occasionally or once a year, as in the case of the harvesting of the seed corn, should be put off or neglected altogether, unless there is a *definite time* and *plan* for the work.

And so I would suggest that some day be set aside on every farm every fall to be known as "*Seed Corn Harvest Day*" and that it be celebrated by harvesting and storing the

seed for next year's planting. In many cases, the work could not be completed in one day, but a good beginning could be made. However, it will require much less time than is generally supposed. Forty acres is the average amount of corn planted on each of the 288,000 farms in Iowa each year, and this requires less than six bushels of seed, provided there is no waste or replanting. But, in order to have plenty to select

FIG. 51—Two hundred bushels of seed corn stored first two weeks in October; forty ears (two strings of twenty ears each) are hung eight inches apart each way.

The above cut represents one of the best and safest methods of storing seed corn. Fifteen or twenty ears are tied together with a piece of binding twine and hung from horizontal wires suspended from the rafters of the ceiling by other wires. *First:* This gives thorough circulation of air, and thus prevents molding or sprouting. *Second:* It allows the corn to dry out rapidly and completely, and thus avoids danger from freezing, during the bitter cold weather of November and December. *Third:* There will be little danger from mice and rats.

from and to provide against possible accident, not less than fifteen or twenty bushels to each forty acres should be saved. One of the very best methods for gathering the seed is to go into the best and earliest planted fields with bags or baskets and select well matured ears from the most vigorous stalks. The ears should then be stripped of their husks and tied together, ten or twelve ears on a string, and hung in the attic or in a spare room upstairs or in a dry cellar *at once* on some

wires where there is a good circulation of air and where it will be protected from the bitter cold, freezing weather of November and December.

The twenty-one strings of seed corn shown in the cut require a space less than six feet long by twenty inches wide, and yet this amount of seed will plant more than fifteen acres.

The advantages of this method of storing are: *First:* That it gives better protection from mice than where it is spread on the floor or corded in piles or put in racks. *Second:* It gives better circulation of air, which allows the corn to dry out quickly

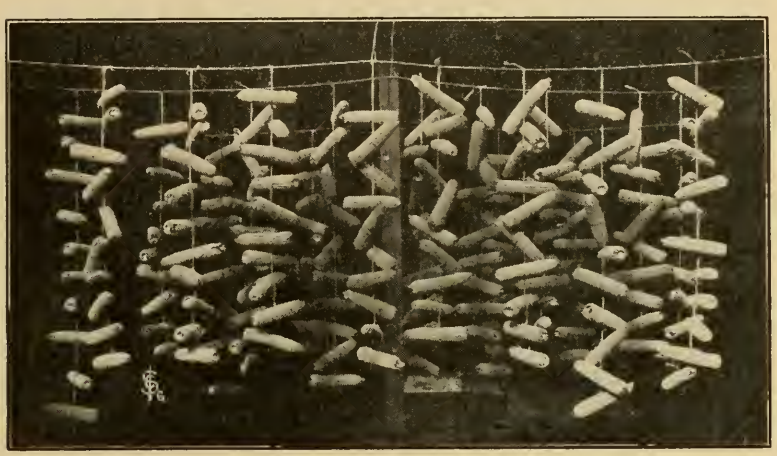

FIG. 52—The twenty-one strings of corn are hung to wires in the attic in a space less than six feet long by twenty inches wide, yet there is sufficient to plant fifteen acres.

and thoroughly, thus protecting it from molding and sprouting and from being frozen while it is yet sappy. The greatest *enemy* to good seed corn is *hard freezing* while it still *contains moisture*, consequently there is more dnager from late harvesting than from too early harvesting. However, it is not a good plan to harvest the seed in September while the corn is immature, as it is more difficult to preserve, will be chaffy and give weaker plants than corn which has been allowed to fully mature on the stalk.

PLACE FOR STORING SEED

Taking all things into consideration, probably there is no better place to store seed corn than in the attic. In the nearly

5,000 samples of seed corn sent to the college for testing the past two years, those preserved in the attic generally gave the strongest germination and also the highest per cent. The experiments conducted at the college, where seed was stored in over forty different ways, also show that the attic is one of the very best places for seed corn. The second best place seems to be in the cellar and especially the furnace room. There are several objections to the average cellar. It is apt to be too damp and the corn must be well dried before putting in the cellar and it must not be corded up or put in piles, but hung up. There is more danger from mice and generally there it less room, but it has one great advantage, in that it protects the corn from hard freezes.

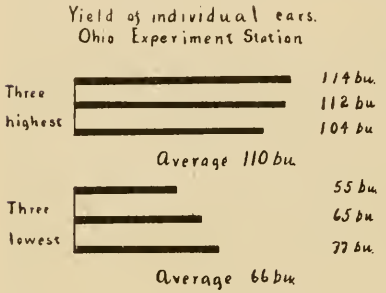

FIG. 53—Prof. C. G. Williams, of the Ohio Experiment Station, selected twenty-four of his best ears of seed corn. These were shelled separately and planted side by side, each ear in a row by itself. The corn was planted five kernels per hill, thinned to three stalks after coming up.

Notice—*First:* That one ear yielded at the rate of one hundred and fourteen bushels per acre, while another yielded fifty-five bushels.

Second: That the one hundred and fourteen bushel ear produced no worthless stalks, while the fifty-five bushel ear produced fifty-eight barren or worthless stalks, yet each of these rows contained exactly the same number of stalks.

Third: That the second best ear produced at the rate of one hundred and twelve bushels per acre, with only fifteen barren stalks, while next to the poorest ear yielded but sixty-five bushels per acre and had fifty-two barren stalks.

Fourth: That the three highest yielding ears averaged one hundred and ten bushels per acre, while the three poorest of the twenty-four ears produced only sixty-six bushels, or a difference of forty-four bushels per acre.

Seed that is hung in the barn or under an open shed generally comes through the winter in fair condition, provided it was harvested and hung up during the early part of October, yet the experience of the last two years shows that much of the seed stored in this way was either killed or greatly weakened. During the warm damp spells, the seed gathered moisture and was injured by the cold freezes that followed. It should be remembered that freezing cannot do the corn any possible good and it may greatly injure it.

It is quite generally supposed that if the seed sprouts in the spring it is all right. As a matter of fact, much of it has often been so weakened that it will not grow, especially if the

ground is cold or the seed is planted too deep, or if it does grow, gives only weak stalks.

We cannot afford to be careless with our seed corn. It means too much. Poor seed means a poor stand; not only is a portion of our field idle, but we must cultivate the missing hills and the one-stalk hills and the poor and worthless stalks. Thousands of people this year worked more than a third of every day on ground that produced nothing, simply because they planted weak seed. Do not depend for seed upon the occasional good ear found throughout the husking season. The

FIG. 54—Rows of Corn Planted from Different Ears.

Anyone who will select one hundred of what appears to be his best seed ears and plant them in separate rows, side by side, watch them grow through the summer, harvest each row separately in the fall and weigh the corn, will certainly be convinced of the tremendous importance of *knowing*, not guessing, that the eight hundred kernels from an ear are strong and vigorous.

corn will be injured by freezing before it is husked, or before it has had time to become dry after husking.

One of the best plans I know of is to begin in March, when testing the corn for planting, by selecting eighty or one hundred or more of the very best ears from the seed corn. These ears should not only be splendid ears in appearance, but the six kernels must show uniformly *strong, vigorous* sprouts in the germination box test.

SELECT BREEDING AT TESTING TIME

The very best time to select these choicest ears is when the germination box is being taken off. We can see the sprouts

of the six kernels from all the ears side by side. These ears should then be butted and tipped and each ear shelled by itself and carefullly studied. The kernels should have a bright, cheerful appearance, be full and plump at the tips and have a large, clear germ, otherwise they should be discarded. The corn from these remaining ears should be mixed together and planted on one side of the regular field. I would emphasize the importance of planting this choice seed at the time of the first planting; that is, I should begin my first field with this seed, putting it on the south or west side of the field, unless there is danger that it will become mixed from some neighbor's corn near by, of a different variety. In this case, I would put it on the other side of the field. The important thing is to get it in early, and, if possible, on fall-plowed ground. This will allow the corn to become thoroughly matured early next fall. The great importance of this cannot be overestimated. It is the late maturing corn that is caught by the freezes, as there is not sufficient time for it to dry out.

FIG. 55—No. 1 is an illustration of a good stalk, well balanced, the ear about four feet from the ground, well set and droops sufficiently, when ripe, to shed the rain. No. 2 shows a rather weak stalk with long joints, and the ear set too high and much too near the top.

SELECT NEXT YEAR'S SEED FROM THIS BEST CORN

The seed corn for the next crop should be selected from this patch, which was planted from the very best ears. It is

a very common practice to select the occasional good ears found throughout the entire husking season. There are three important reasons why this should not be done. In the first place, we are more likely to neglect the work until too late, when we find ourselves without good seed for the next year. Again, many of the kernels on these good ears, selected throughout the entire field or season, have necessarily been fertilized by pollen from the scrub stalks and those which are perhaps barren. In other words, we have simply selected a good female, but know nothing of the character of the male stalks from which the pollen came that fertilized the kernels. On the other hand, if our seed is all selected from the seed patch planted only from the very best ears, we are much more certain of good parents on both sides.

FIG. 56—Height of Ears.

As extremely high ears tend to be later than those lower down, they should not be used for seed purposes. Ears, on the other hand, that are too low, tend to extreme earliness, and as these two classes do not mature well together, they should be avoided, and none but ears borne at a uniform height should be used for seed.

One of the most serious results from depending on the occasional good ear found throughout the entire husking season is that many of the fields are late and the corn immature and the husks will prevent the corn from drying out properly and, as a consequence, it is frozen before it is husked, or at least before it has had time to dry out after husking. Again, we often begin harvesting our poorest fields first and delay saving seed until we come to our "best fields."

There are several cautions which should be observed in the storing of seed corn.

First: Do not put immature or freshly-gathered seed corn in a warm room on the floor or in piles; it will either sprout or mold, or both. The corn should be hung up and the windows left open for a good circulation of air.

Second: Seed corn should not be left in barrels and boxes, nor on the floor or porch in piles. It should be properly taken care of at once, as soon as harvested—that night.

Third: Do not store seed corn over the laundry room, nor over the stable, as it will gather moisture and be injured by freezing during the winter.

Fourth: Do not depend upon the crib for seed corn.

The most critical time for seed corn is during the first month after it is harvested while it is green and sappy. There is danger that it will mold or grow if the room is warm and the circulation of air is not good. On the other hand, there is danger of its freezing unless protected. Corn dries out much more slowly than is generally supposed. The experiments at the college show that corn which shrunk twenty-six per cent. during the year in a small crib had lost on January 1st but eight per cent. This corn was put into the crib on October 27th.

FIG. 57—Bushel crate of corn ready for shipment. Size, 11 inches wide by 12 inches deep by 32 inches long, inside measurement. The slats are 3 inches wide, the side slats are of one-half-inch and the end slats of five-eights-inch material.

Let me again emphasize the importance of selecting, say, one hundred of the choicest ears, planting them on one side of our earliest planted field. Out of this seed patch the seed for next year's crop should be selected not later than October 10th to 15th and hung up in the attic at once, where it can dry out thoroughly before the severe freezes.

Let us have a *time* and a *definite plan* for harvesting and storing our seed corn. One day devoted to the seed corn at the proper time may be worth more to us than an entire month of hard work next summer put on to a poor stand of corn.

CHAPTER V

WHAT IS A GOOD EAR OF CORN, OR HOW TO SELECT AND JUDGE CORN

Perhaps the four most fundamental things to be considered in the judging of corn or in the selecting of seed are:

First: Will it grow? That is, will it all grow and grow uniformly, giving an even stand? Has it vitality—strong germinating power?

Second: Will it mature; that is, will it ripen in the vicinity, not only this year, but every year for ten years? If not, it is too risky.

Third: Has it constitution; that is, producing power? Has it those characteristics which make us know that it will *do* something in spite of cold ground and unfavorable conditions?

Fourth: Has it breeding characteristics? Will it reproduce itself? Has it forty, fifty or sixty years of intelligent selection and improvement back of it to a purpose? Has it been mixed with brains?

Let us take up some of the points to be considered under each of the above head.

FIRST: HAS IT LIFE? HAS IT STRONG GERMINATION POWER? WILL IT GROW?

In the final selection of seed corn to plant no one has any moral right to *guess* that the kernels on an ear of corn will grow when he can find out definitely what they will do by testing a few kernels from each ear as described in Chapter II.

In the preliminary work of sorting out and selecting the ears of seed corn we are obliged to depend on the appearance of the ears and kernels, and this is especially true with the judge at a contest, where he must pass upon the samples after only a brief examination.

In studying the germinating power of the corn, it is essential that several kernels be removed from every ear, representing different parts of the ear, and laid at the end of the ear where

they may be studied with the ear. Some indications of the lack of strong germinating power are: black, salvy or cheesy appearance of the germ when the kernels are cut or broken open; shrunken, blistered or wrinkled germs; starchy, blistered backs of the kernels; kernels with shrunken pointed tips, leaving space at the cob between the kernels; adhering to the kernels of the chaffy part of the cob when the corn is shelled; starchy, dull, dead appearance of the ear; loose, chaffy condition of corn on the cob, and especially a moldy appearance of the cob or of the corn.

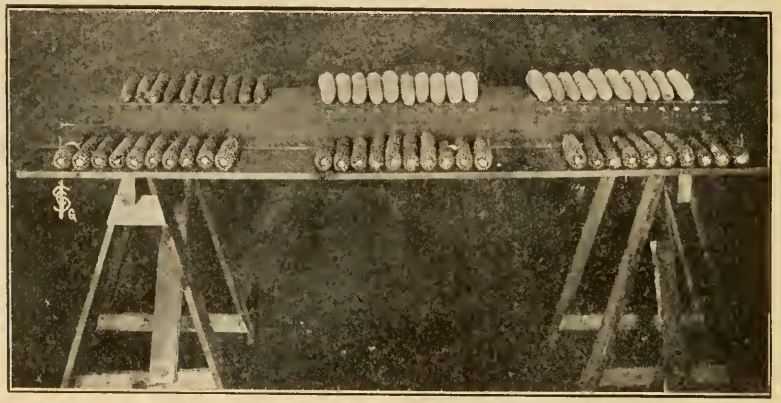

FIG. 58—The samples of ten ears each entered in a corn contest laid out ready for judging. The object should be to give first place to the ten ears which will prove most *profitable* per acre to grow, year after year, under the conditions as they exist in the vicinity where the contest is held.

SECOND: WILL IT MATURE; THAT IS, RIPEN IN THE VICINITY EVERY YEAR? IS IT SAFE?

Maturity is one of the most important things to be considered, especially in the northern part of the corn belt, where there has been a tendency to grow late maturing varieties, and to select too large ears, or ears with too deep grains, which tend toward lateness. As a consequence, the corn is improperly matured, chaffy, and grades low on the market. A load of immature, chaffy corn, loose on the cob, light and starchy, is often worth scarcely half as much in the feed lot as a load of well-matured corn. To this loss we must add the difficulty of keeping immature corn. It generally molds more or less, and

almost always, during March and April, when the corn thaws out, the heart or chit of the kernels, which is the most valuable portion of the grain, turns black, becomes strong and unpalatable and the feeding value is greatly reduced.

Of the thousands of samples of corn sent to the college each spring to be tested, it is almost invariably the late maturing varieties that have lowest vitality. This is due largely to the fact that the corn matured so late that it did not dry out thoroughly before the severe freezes of November and December. What we need is not large, late maturing kinds of corn, but a better stand, with every stalk bearing a medium-sized, well-matured, solid ear of corn.

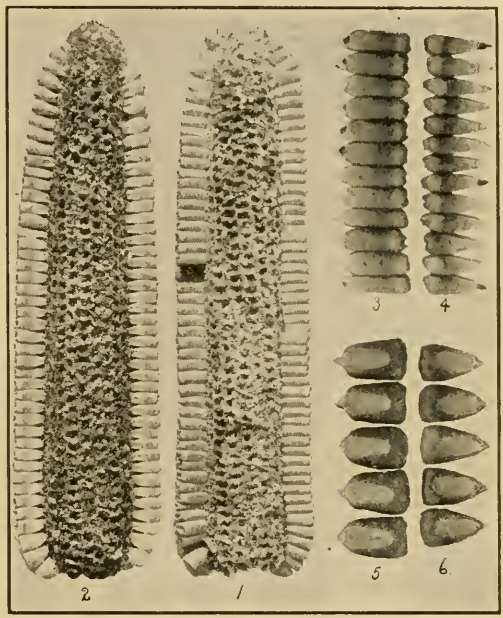

FIG. 59—Space between the kernels next to the cob objectionable. Ears 1 and 2 are the same length and circumference. Ear No. 1 weighed 13.45 ounces. Ear No. 2 weighed 10.12 ounces. Ear No. 1 shelled out thirty-three per cent. more corn than ear No. 2. No. 3 is edge view of the kernels taken from ear No. 1. No. 4 is edge view of kernels from ear No. 2. Nos. 5 and 6 is a flat view of the kernels. Ear No. 2 should be discarded for seed purposes. *First*, because it will shell out a smaller proportion of corn to cob; *second*, because it is poorer in feeding value; *third*, because the kernels give weaker stalks.

One small ear of corn weiging ten and one-half ounces to each of the 3,556 hills per acre, would make thirty-three bushels per acre, or more than the average yield of the corn belt for the past ten years. What we need now is another ear of corn to each hill.

The indications of immaturity are chaffiness, looseness on the cob, sappiness, dull and starchy appearance of kernels, the chaffy portion of the cob adhering to the kernels, when removed

from the cob, or the tip cap of the kernels breaking off leaving the germ exposed, shriveled or wrinkled appearance of the tips of the kernels, the doughy appearance or cheese color of the germ or heart of the kernel.

Fig. 60—Shows a strong, vigorous stalk and a weak one. At the time when those stalks were taken from the field (October 10), the ear on No. 1 showed a droop at the tip a little more to prevent the water from running under the husks and molding the butt of the ear.

THIRD: HAS IT CONSTITUTION OR PRODUCING POWER?

It has already been pointed out that there is a great difference in the producing power of different ears of corn. There are certain things which indicate vigor and strength, or the lack of it. In figure 60 it is apparent that the right hand stalk has the greater strength. The left hand stalk is spindling, the shank of the ear is long and so weak that the ear has broken down, the joints are long and the leaves narrow and pale in color and the tassel itself shows weakness.

There is not space here to bring out the many differences shown by the stalks in this figure, but anyone who has really given much attention to corn will appreciate fully the importance of planting the corn from the ninety or one hundred best ears on one side of the field, so that he may go through this part of his field in October, with bags, and select the best ears from those stalks which indicate constitution and vigor.

In connection with the ears of corn and the kernels, there are many things which indicate strength or the lack of it. Ears

with compressed butts, very small shank attachments, or ears with small pointed tips partially covered with small, yellow, flinty kernels, ears with a dull and starchy appearance, or ears with kernels having small germs or weak pointed tips are generally weak; i. e., produce weak plants, which will not endure unfavorable conditions, such as cold, wet ground in spring, or dry weather later in the season,or resist the attack of insects,etc.

A large germ or heart in the kernels of the ear indicates not only strength and vigor, but also high feeding value.

One of the best indications of strength is the way the six kernels from each ear sprout in the germination box.

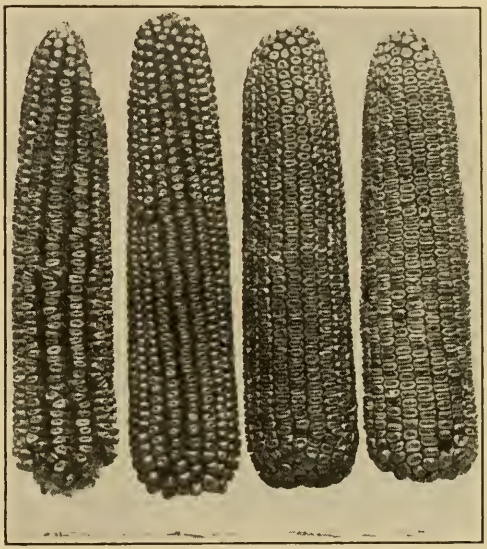

Fig. 61—Furrows between rows. Ears like No. 1 with no furrows between the rows are apt to be dull and lacking in weight, with spaces between kernels at cob. The furrows are too prominent on ears 3 and 4.

FOURTH: HAS IT BREEDING? IS IT TRUE TO TYPE? WILL IT REPRODUCE ITSELF? HAS IT YEARS OF SELECTION TO A PURPOSE?

Probably the next most important thing to take into consideration is the trueness to type, or breed characteristics. The ears to be selected for seed, or for the exhibit, should be uniform in size, shape and color, and should be free from mixture. The kernels of the different ears should also be uniform as to color, size and shape, maturity and other characteristics. The real significance of having definite and uniform characteristics is not generally appreciated. Corn practices "open" or "free" pollination, and, as a consequence, much of the corn has become badly mixed. The following are some of the bad results of mixture:

First: Instead of improving it tends to deteriorate or to revert, and generally becomes inferior to either of the kinds which were mixed.

Second: There is generally a large percentage of barren stalks due to the difference in time of silking of the two or more varieties which formed the mixture, and to the increased tendency to vary; hence, we find in a mixed corn many stalks silking before the pollen is shed, and others after it has gone.

Third: There is a wide range in time of maturity, and consequently much soft, chaffy corn; frequently a portion of the kernels of the same ear will be much more immature than others. These later maturing kernels contain more moisture than the riper ones and are quite likely to be injured by freezing and refuse to grow when planted or will give weak plants.

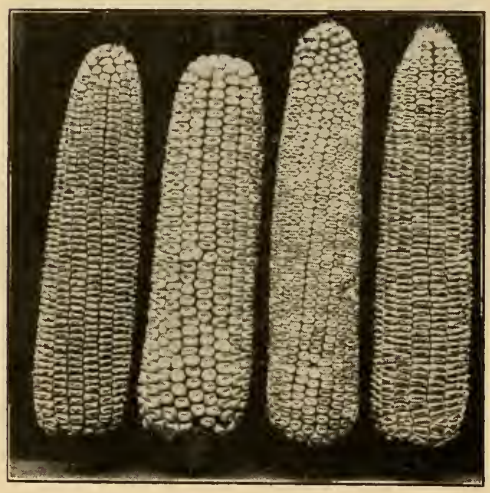

FIG. 62—These ears vary greatly in size and shape of kernel. The planter will not drop the kernels from these ears evenly. They will also give too much variation in time of maturity, character of growth, etc.

Fourth: The varieties which become mixed generally have different types or characteristics of kernels. There will be a tendency for some of the ears to have broad, shallow or thick kernels, while others will have narrow, deep or thin kernels. This lack of uniformity in size and shape of kernels makes it impossible to secure an even dropping of the seed by the planter, which means a poor stand and a reduced yield. In the tests which have been made with a large number of samples from farmers, those most badly mixed generally gave the lowest yield.

FIG. 63—A thousand men from the farms of Iowa come to the Agricultural College annually to take advantage of the winter Short Course in corn judging, and go back to their homes to talk for better corn and to grow better corn. The man with the ear of corn in one hand and a pointer in the other is Prof. Holden.

The score card is simply a subdivision of these four fundamental propositions. Its purpose is:

First: To aid the judge to keep in mind the principal things to be considered.

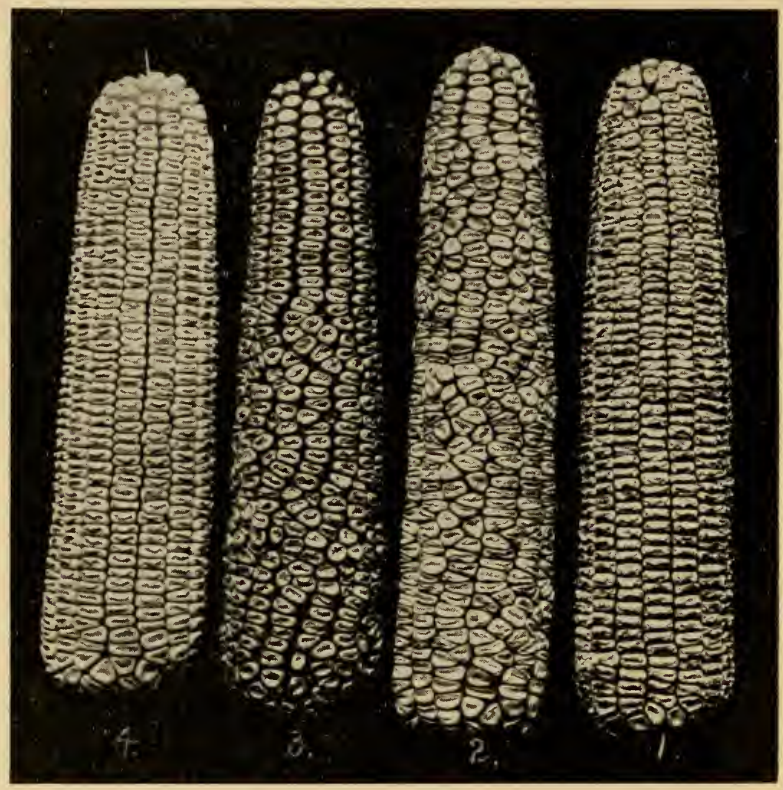

FIG. 64—In selecting seed ears, Nos. 2 and 3 should be discarded, as no planter will drop a uniform number of these kernels per hill. Ears Nos. 1 and 4 have kernels of uniform size and shape, and when the butts and tips were shelled off the planter dropped three kernels to a hill ninety-three to ninety-five times out of every hundred tests, while ear No. 2 tested seventy-four threes, nineteen twos, six ones and one five. Five stalks in one hill and one in the next does not make an average of three stalks per hill in yield.

Second: To aid in establishing a uniform basis for study and comparison.

Third: To prevent the laying of undue stress on some

one or two points and omitting others entirely, which are of more importance.

Fourth: Finally, the great purpose of the score card is better corn; i. e., greater profits from each acre and for each day's labor put on that acre. It should not be followed blindly nor even mechanically, but intelligently. After all, the judge, or the man selecting his seed, is the principal factor, and upon

POINTS	1	2	3	4	5	6	7	8	9	10
1. Trueness to Type 10										
2. Shape of Ear 10										
3. Purity of Color in Grain and Cob 5										
4. Vitality, Maturity, Germination Power 20										
5. Tips of Ears 5										
6. Butts of Ears 5										
7. Uniformity of Kernels 5										
8. Shape of Kernels 5										
9. Length of Ear 5										
10. Circumference of Ear 5										
11. Furrows Between Rows 5										
12. Space Between Kernels at Cob 10										
13. Proportion of Corn to Cob 10										
Total 100										

his knowledge and experience the final decision as to whether this sample or that, whether this ear or that, shall receive the award or be selected for planting must depend.

The score card on the preceding page, with some modifications, is now in general use throughout the United States:

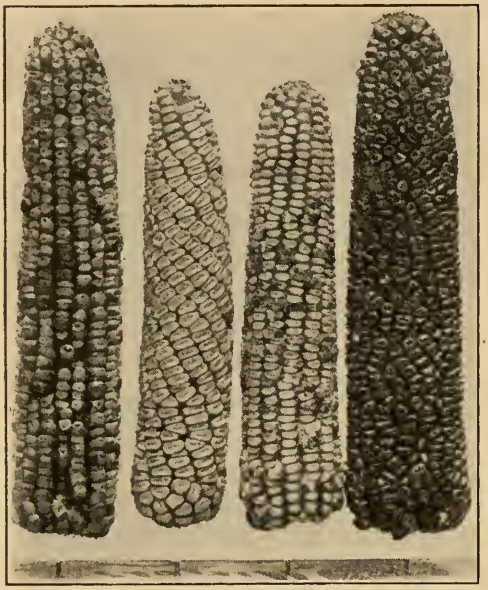

FIG. 65—Scrub Ears of Corn.
Ears 1 and 4 are from good, healthy, vigorous stalks. No. 4 was late, poorly pollinated, and as a consequence the corn is of little value. Ear No. 2 shows the effect of mixture with late corn. Some of the kernels were much later in maturing than others, and the crowns have been broken open and in some cases the kernels rotted; the stalks which produced these ears have distributed millions of grains of pollen throughout the field to fertilize the silks of many of the best ears which will be collected for seed.

EXPLANATION OF THE POINTS IN THE SCORE CARD

1. TRUENESS TO TYPE OR BREED CHARACTERISTICS. 10 POINTS.—The ten ears in the sample should possess similar or like characteristics, and should be true to the variety which they represent. Several representative kernels should be taken from each ear and placed germ side up in front of the ear and studied in connection with the ear. Too little attention is generally paid to the kernels in selecting seed and in judging samples.

2. SHAPE OF EAR. 10 POINTS. In shape the ears should conform to variety type. Each ear should be full and strong in the central portion and not taper too rapidly towards the tip. This indicates strong constitution and good yield.

3. PURITY OF COLOR IN BOTH GRAIN AND COB. 5 POINTS. —In color the kernels should be true to variety and free from mixture. Difference in shade of color, as light or dark red, white or cream color, must be scored according to variety characteristics.

Cob.—The cobs should show uniformity of color, shape and quality, indicating purity and good breeding.

4. Vitality, Maturity, Germination Power. 20 Points. —Corn should be in good market condition; should show good constitution and be capable of producing plants of strong,

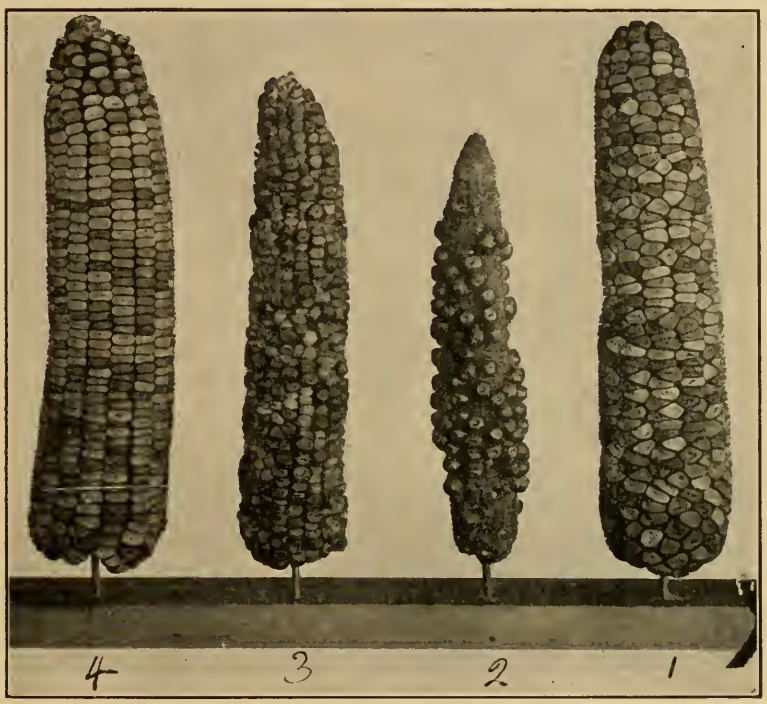

Fig. 66—Mixing of Varieties Bad.

The crossing or mixing of different varieties or types of corn generally reduces both yield and quality. Where the types crossed vary most, the damage is generally greatest

1. The fixed characteristics of each variety are broken up; that is, become unstable and the tendency is to revert back to the older forms—to degenerate.

2. There will be a lack of uniformity in size and shape of kernels, and it will be impossible to secure regularity of drop by the planter.

3. The kernels on the ear will ripen unevenly; some of the kernels, being late, immature and sappy, are injured by the freezes in November and December, and, consequently, a poor stand is secured the following spring.

4. It produces unevenness in time of silking, the very earliest and latest ears frequently being poorly fertilized and developed. (See ears 2 and 3).

vigorous growth and yield. All indications of freezing or other injury from exposure, and all evidence of immaturity, such as kernels with adhering chaff, black tips caused by the tip cap adhering to the cob, shrunken, dark or blistered germs, and

shrunken, blistered or starchy backs must be marked according to the judgment of the scorer. When selecting for the best kernel aside from type, the broad wedge-shape is most desirable.

5. Tips. 5 Points.—Tips should be regular, uniform, and properly proportioned to the body of the ear. The rows should be well carried out and the kernels conform closely to those in the main body of the ear in shape and size. The proportion of tip covered or filled must be considered. Long pointed tips, as well as blunt, flattened or double tips, are objectionable.

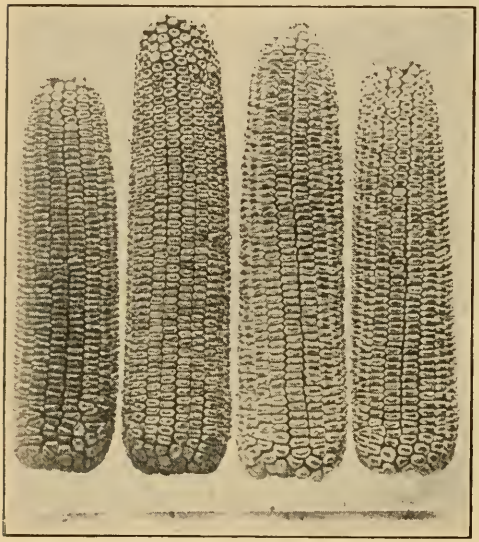

Fig. 67—The above ears are from different varieties of corn and illustrate very good forms or types. The ears are full in the middle, showing good constitution and breeding. The kernels on each ear are uniform in size and shape, and will be dropped uniformly from the planter, giving an even stand.

6. Butts. 5 Points.—The rows of kernels should extend in regular order over the butt, leaving a deep depression when the shank is removed. Opened and swelled butts, depressed and flat butts with flattened glazed kernels, are objectionable and must be cut according to the judgment of the scorer.

7. Uniformity of Kernels. 5 Points.—The kernels should be uniform in size and shape, making it possible to so grade the corn as to secure even dropping by the planter. This is essential in securing a good stand. Not only should the kernels be uniform on the individual ear, but they should be uniform throughout the sample.

8. Shape of Kernels. 5 Points.—Kernels should be so shaped that their edges touch from tip to crown. The tip portion of the kernel is rich in protein and oil, and hence of high

feeding value. Kernels with large germs insure strong, vigorous growth, as well as richness in quality of kernel.

9. Length of Ear. 5 Points.—The length of the ear varies according to variety, type and the characteristics sought for by the individual breeder. Uniformity of length is to be sought for in a sample, and a sample having even length of ears should score higher than one that varies, even if it is within the limits. Usual length of ears for the northern sections of the corn belt, eight and one-half to nine and one-half inches; central section, eight and three-fourths to nine and three-fourths inches; southern sections, nine to ten inches. Very long ears are objectionable, as they usually have poor butts and tips, broad, shallow kernels, and hence a low percentage of corn to cob.

10. Circumference of Ear. 5 Points.—The circumference of the ear, aside from conformity to its variety or type, should be in symmetry with its length. An ear too great in circumference in proportion to its length is generally slow in maturing, and too frequently

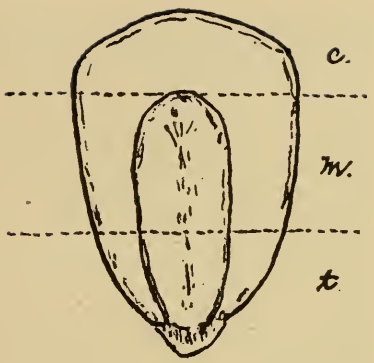

Fig. 68—Composition of the Crown, Middle and Tip Portion of the Kernel.

Parts.	Per Cent. Oil.	Per Cent. Protein.	Total.
Crown (c)	1.0	13.5	14.51
Middle (m)	3.33	9.98	13.31
Tip (t)	12.02	12.26	24.28

Ears whose kernels have strong, full tips are richer and give stronger plants than those which are thin and pointed at the tips.

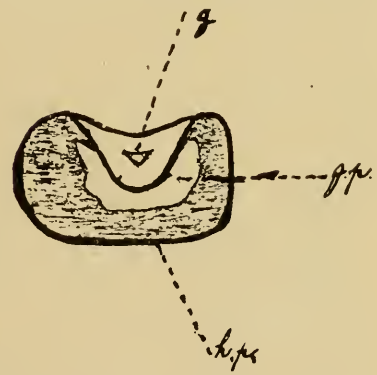

Fig. 69—Cross Sections of a Kernel of Corn.

The following table shows the composition of the parts of a kernel of corn:

	Per Cent. Oil.	Per Cent. Protein.	Per Cent. Ash.	Total.
Germ or heart (g)	36.6	19.4	10.0	66.0
White floury portion (f,p).	.8	7.9	.5	9.2
Hard, horny portion (h,p).	1.1	10.8	.65	12.55

It will be noticed from the above table.

First, that the germ is many times richer than the other portions of the kernels in the three most valuable feeding constituents; viz., oil, protein and ash. *Second*, that the white, floury-looking portion is the poorest. Select ears for seed that have kernels with large, deep germs.

FIG. 70—The upper row shows the depth of germ when the kernels are split in two lengthwise through the middle of the germ. Nos. 21, 24, 27, 28, 29, 33 and 35 show very deep germs and are from ears rich in protein and oil, No. 35 being from the ear richest in protein of 1,600 tests, while Nos. 22, 23, 36 and 37 are from ears very poor in feeding value, as the germs are very small. Ears with kernels having large germs are not only richer in oil, protein and ash, but also produce more vigorous plants with a larger yield. The two lower rows (1 to 20) illustrate the variations in depth of germ in kernels from different ears when cut in two crosswise of the germ about one-third the way from the tip to the crown of the kernel. Kernels 2, 14 and 18 have especially shallow germs.

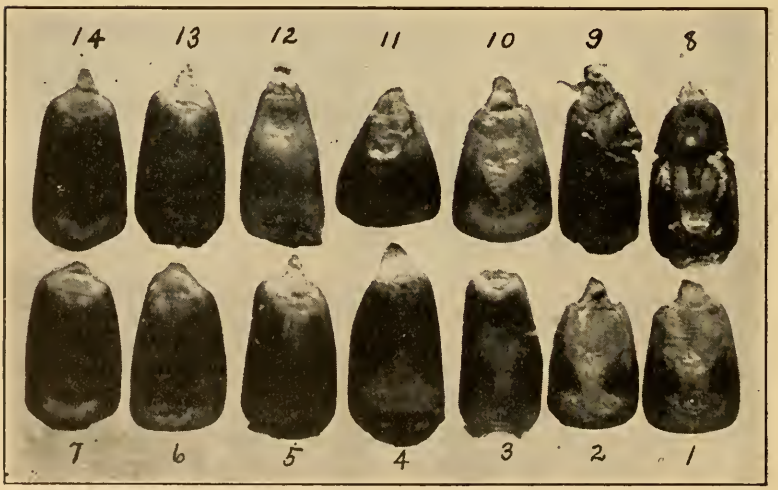

FIG. 71—Strength and weakness are often shown clearly by examining the backs of the kernels. Nos. 1, 2, 10 and 12 have a large proportion of starchy material, indicating immaturity. Such kernels have a dull, dead color and are sure to be low in vitality, as they are generally produced by late, weak stalks. The crown of No. 3 is very thin and weak. No. 11 is a poorly shaped kernel, and in addition is starchy and shrunken at tip. Being thin, as well as pointed, its vitality is very low. No. 4 is poor, in that the crown is very thin and starchy; 5 and 12 are weak just above the tip, as the depression shows. Nos. 7 and 14 are well developed, bright and strong; 6 and 13 are less perfect, but are still bright and cheerful kernels. All four carry the horny part to the crown of the kernel.

results in soft corn. Dimensions for northern section of the corn belt, six and one-half to seven inches in circumference, central section, six and three-fourths to seven and one-fourth inches; southern section, seven to seven and three-fourths inches. Measure the circumference at one-third the distance from the butt to the tip of the ear.

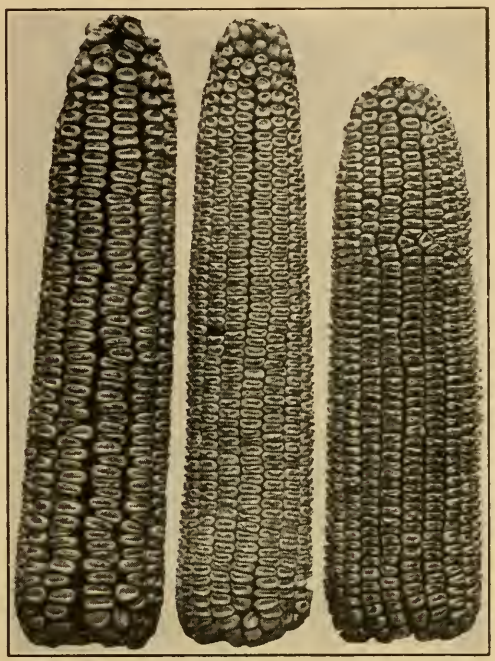

Fig. 72—These ears vary too much in type and character of kernels. We should select toward some one type.

11. Furrows Between Rows. 5 Points. — The furrows between the rows of kernels should be of sufficient size to allow the corn to dry readily, but not so large as to lose in proportion of corn to cob.

12. Space Between Tips of Kernels at Cob. 10 Points. — This is very objectionable, as it indicates immaturity, poor constitution and poor feeding value and low per cent. of corn to cob.

Fig. 73—Kernels with large germs best for seed. Ears whose kernels have large germs or hearts are rich in feeding value; that is, have a larger per cent. of protein, oil and ash. They also give stronger plants and a larger yield.

13. Proportion of Corn to Cob. 10 Points. — The proportion of corn is determined by weight, depth of kernels, size of cob, maturity, furrows and space at cob; all

affect the proportion. In determining the proportion of corn to cob, weigh and shell every alternate ear in the sample. Weigh the cobs and subtract from the weight of the ears, which will give the weight of the corn; divide the weight of the corn by the total weight of ears, which will give the per cent. of corn.

FIG. 74—From the Page County, Iowa, Experiment Station. The shock of stover and white corn at the left was grown from seed that has been carefully selected and grown in the county for several years. It is not an accident.

Attention has been given to the selection and care of the seed with a view to securing a high yield and a high quality of corn for that particular district. The three ears that are held by the man in the center of the group were produced upon three stalks in a single hill and weighed sixty-seven ounces on November 10. The twenty-three seed ears from this shock corded up on the ground bears tribute to the intelligent care given the seed corn by this man in the past.

The stover, basket of corn and seed ears on the right were grown from seed that was furnished by another man, and how different are the results, yet hundreds, and it would be safe to say thousands, of acres of corn were grown from the same seed last year.

Per cent. of corn should be from eighty-six to eighty-seven. For each per cent. short of standard, a cut of one and one-half points should be made.

Each sample should consist of ten ears of corn.

CHAPTER VI

IMPORTANCE OF THE CORN CROP

The people of the United States at the beginning of the twentieth century are just waking up to the fact that King Corn has really taken possession of the country. He has stolen in quietly, but so rapidly that this year he represents a value of $1,120,000,000, or more than the combined values of cotton and wheat. In the center of the corn belt, the value of the corn crop exceeds that of all the other crops combined.

No other crop exerts so great an influence over the destinies of the enterprises of man. Yet this greatest of American crops has no long line of respectable and established customs and practices to guide us in its production. It is a new crop, only a few years from the hands of the Indian, when a few hills were planted and the entire crop ground in a stone cup; and it is but as yesterday that our fathers planted the corn crop with a hoe, and cared for it with the same hoe, aided by a one-horse cultivator. Now and then, through the year, a half bushel or so was shelled and ground at the water mill for family use, but the chickens, pigs and horses received the balance of the crop, though only a few ears each day. No one can realize what a mighty change has been wrought by this crop who has not personally seen the hoe give way to the hand planter and in turn to the check rower, the five and six-acre to the eighty and one-hundred-acre fields, the little handful of hominy and meal by the miller to the multiude of different products now shipped daily from our factories by train loads to every country of the globe.

But we are only in the beginning of the development of this great crop, and especially as regards production. A corn crop failure in the corn belt has never been known. The lowest yield ever produced in Iowa was fourteen bushels per acre, or about the average of the wheat crop of the United States.

While the corn belt, that is, the region where corn exceeds in value any other crop, will gradually and rapidly extend to

the north, east and south, yet the really great problem for the farmer today is not how to grow more acres of corn, but how to produce greater returns from each acre and from each day's labor put upon that crop.

Fig. 75—Uniformity in Height of Ears.

Fig. 75 shows two hills of corn. No. 1 has two stalks, each of which has produced a good ear. Both stalks are strong and vigorous and the ears are of uniform height. Hill 2, produced three stalks, each of which bore an ear at a uniform and desirable height. This is an evidence of good breeding. Uniformity in height of ear is not so important as uniformity of kernels, but it is important in that it indicates good breeding and, in ears of the same variety, a uniform time of ripening. If each of the 3,556 hills per acre produced an average of two very small ears like those in hill No. 1, weighing eleven and 13 ounces, it would make a yield of seventy-six bushels; three ears like those in hill No. 2, averaging fourteen ounces each, would make the yield one hundred and thirty-three bushels, or one hundred and three bushels more than the average for the corn belt.

IMPORTANCE OF THE CORN CROP.

The great importance of the corn crop in the United States is shown by the fact that of 176,000,000 acres devoted to all kinds of grains in 1905, 94,000,000 acres, or more than fifty-three per cent., were devoted to corn alone. In this same year, the value of all the cereals grown in the United States was $1,840,000,000. Of this amount, $1,116,000,000 worth, or more than fifty-five per cent., was credited to the corn crop. Six states lying in the middle west, Iowa, Illinois, Missouri, Kansas and Indiana, produced one-half of this enormous crop.

The table on the following page gives the average annual production of grains in the United States for the five years 1901 to 1905 inclusive.

CROPS OF THE NATION.

There is a common impression that both hay and cotton exceed in value the corn crop.

Kinds of Grain	Millions of Acres	Yield per Acre in Bushels	Millions of Bushels	Value in Millions of Dollars	Per Cent of Total Value
Corn	91.8	24.9	2292	1019	54.6
Wheat	47.2	13.9	660	472	25.3
Oats	28.1	30.9	871	284	15.2
Barley	4.8	27.0	130	55	2.9
Rye	1.4	15.8	29	17	.9
Rice*	.5	30.0	17	13	.7
Buckwheat	.8	18.5	14	8	.4

*Average for 1904-5 only.

FIG. 76—From the Story County, Iowa, Experiment Station.

One man's corn may yield eighty bushels per acre, while that of another man will yield less than forty bushels when grown side by side, under the same conditions. Each spring, samples of seed corn are gathered from about one hundred farmers throughout the county. These samples are taken to the County Poor Farm, where they are planted by hand, three kernels per hill, each sample being repeated three times in different parts of the field. In a test of ninety-four samples, in 1904, the average yield of the five highest was seventy-seven bushels per acre, while that of the five lowest was but thirty-five bushels per acre, and of an inferior quality. Each county should have an Experiment Station on the County Poor Farm for the benefit of the two thousand to three thousand farmers in the county.

The following table shows that the value of the corn crop annually exceeds the combined value of both the hay and the cotton crops:

Crop	Amount	Value
Corn	2,708,000,000 bu.	$1,116,600,000
Cotton	10,500,000 bales	556,800,000
Wheat	692,900,000 bu.	518,300,000
Hay	60,500,000 tons	515,900,000
Oats	953,200,000 bu.	277,000,000
Potatoes	260,700,000 bu.	160,800,000
Barley	136,600,000 bu.	55,000,000
Tobacco	814,300,000 lbs.	53,600,000
Rye	28,400,000 bu.	17,400,000
Rice	13,600,000 bu.	12,900,000
Buckwheat	14,500,000 bu.	8,500,000

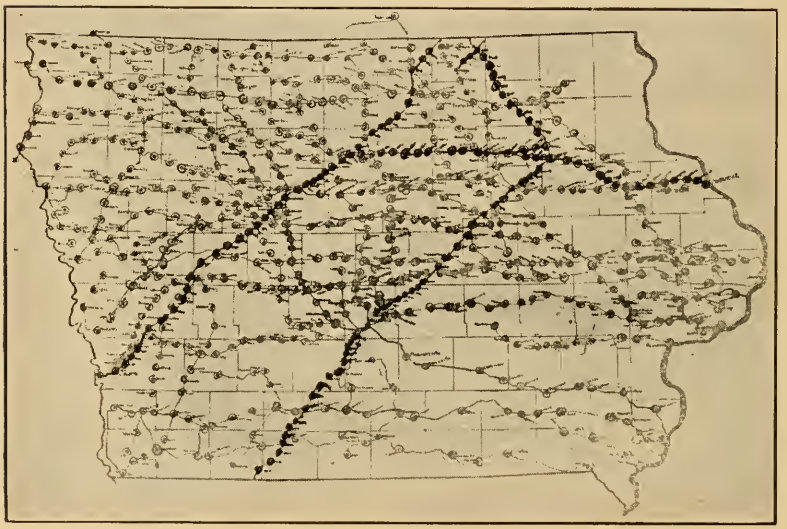

FIG. 77—Seed Corn Special Trains.

Map showing stops made by seed corn special trains in Iowa during 1904, 1905 and 1906—11,000 miles were covered; 789 stops were made; 1,265 lectures were given to 145,700 people in sixty-seven days.

INCREASE IN THE PRODUCTION OF CORN

The following table shows the rate of increase of corn production in the United States for the last fifty years. It will be noticed that the increase is not a gradual one, but quite fluctuating, due to the rapid develoment of the great corn states of the middle west during the last half century. The corn lands of the

United States are practically all developed and the increase in the future will be due largely to careful seed selection and breeding, and to better cultivation, not to an extension of the producing area.

Year	Yield in Bushels	
1830	192,000,000	
1860	836,000,000	41.7 per cent increase.
1870	760,000,000	9.3 per cent decrease.
1880	1,754,000,000	130.6 per cent increase.
1890	2,122,300,000	21.0 per cent increase.
1900	2,666,400,000	20.0 per cent increase.
1905	2,707,000,000	1.3 per cent increase.

FIG. 78—Listening to a Lecture on the "Seed Corn Special."

IOWA'S CORN CROP

The value of Iowa's corn crop is approximately $120,000,000 annually, not including the value of the fodder, or more than one-eighth of the entire crop of the United States, and

nearly equals the total value of all the other crops grown in the state.

WHAT BECOMES OF THE CORN CROP?

It is estimated that seventy-five per cent. of the corn crop is consumed on the farm, that fifteen per cent. is used for manufacturing purposes, that is, goes to the glucose and starch factories and to the distilleries, and that ten per cent. is exported.

There is no other plant from which so many products are made, more than one hundred and fifty products being made

FIG. 79—After the Lecture at the Seed Corn Special.

from the stalk, cob and grain. The following are among some of the more important: several kinds of corn flour or meal, starches, sugars, candies, syrups, alcohol, whiskies, oils, salad dressing, rubber, hominy, brewer's grits, cellulose, mucilage, paste, dextrine, beer, gluten feed, germ oil cake, pipes, paper, etc.

The corn flour aside from being used for cakes, bread, etc., alone, is largely used, mixed with wheat flour, for cooking purposes. It is the opinion of many of the best cooks that the mixture makes better muffins, cakes, etc., than either the wheat or the corn flour used separately.

The starches are used in pastry, the laundry, in the manufacture of baking powders, and in the cotton and paper mills.

The dextrines are used in pastries, and in the manufacture of glues, mucilages of many kinds, paper and cloth boxes, and various fabrics. The sugars and glucoses of many grades enter largely into manufacture of the best candies, table syrups, jellies, preserves, etc.

FIG. 80—Scene at annual picnic at the County Farm, Taylor County, Iowa. More than three thousand people attended this picnic. The field experiments were of great interest to everyone. To the right under the trees were a group of boys judging corn, and during the day judged classes of live stock.

The brewer's glucose and grits are used extensively in the manufacture of beer, both in this country and in Europe.

The oil which comes from the chit or heart of the kernel is used very largely for cooking purposes, in the preparation of salad oils and dressings, as a rubber substitute for waterproof coats, in the manufacture of soaps, etc.

The alcohol, aside from forming the basis of the whiskey

business, is used commercially in more than a thousand different ways. With the tax removed, alcohol will come rapidly into use for cooking, lighting, heating and for power.

The stalks and husks, in addition to forming one of the most important forage crops, are used in the manufacture of mattresses, cellulose and paper. It would be impossible to enumerate all the uses to which cellulose alone is put. It is used in the packing of the wall spaces in battleships, as a packing for deadening and as a non-conductor of heat and electricity. It also enters into the manufacture of smokeless powder and other explosives.

The cobs are largely used as fuel, for pipes, and, when ground, as an adulterant for wheat bran.

In the manufacture of alcohol there is considerable waste material, known as distillery slop, which is used for feeding purposes. The refuse from one bushel of corn will feed one steer one day, so that a distillery consuming five thousand bushels of corn per day will have on feed about 5,000 head of cattle. Two lots, or 10,000, will be fed and sold during the year.

COMPOSITION OF CORN

The following table shows approximately the composition of shelled corn under ordinary conditions.

Starch	70.	per cent.
Water	12.	per cent.
Protein	10.	per cent.
Oil	4.3	per cent.
Fiber	2.2	per cent.
Ash of mineral matter	1.5	per cent.

When the corn is received at a glucose factory, it is first soaked, then ground, and the germ is separated from the rest of the material. The germ is then dried, ground, steamed and pressed to remove the oil. The cake which remains contains a high per cent. of protein and oil, and is known as germ oil cake, being used extensively for feed. The protein and other material which is washed out of the starch, when mixed with the bran and ground together, is called gluten feed.

CHAPTER VII

CORN

Corn, Indian corn, or maize (Zea Mays) is native to America. It was not known to Europe, Asia or Africa before the discovery of America. It is found in the mounds of the Mound Builders, a race of people who inhabited America prior to the Indians. In the Smithsonian Institute, at Washington, may be seen specimens of corn taken from the tombs of the ancients. One specimen of corn was found eleven feet underground in a jar buried in a grave with a mummy.

The best evidence at hand would seem to point to Central America as the original home of Indian corn.

Corn, like wheat and oats, belongs to the grass family, is an annual, but, unlike most of the other grasses, produces its grain on one or more shoots from the joints on the side of the stalk.

There are six different classes, or races, of corn:

POP CORN

The pop corns are generally smaller than the field corns, have many suckers, and the kernels are small, hard and flinty. There is a very small proportion of the white floury-looking material in the kernels.

SWEET CORN

The characteristics of the sweet corns are less starch and more sugar than in other kinds, and it also remains in the "doughy," or "roasting ear" stage much longer, and the kernels are much wrinkled when thoroughly matured or ripened. They are especially valuable for canning, boiling or roasting, and some of the varieties, like the Stowell's Evergreen, are much used for fodder.

POD CORN

Pod corn, or husk corn, is of no special value as a field crop,

being grown merely as a curiosity. Each kernel is enclosed in husks, but in other respects it is like ordinary field corn.

FLOUR CORN

The kernel of the flour corn is shaped like those of the flint varieties, but unlike them in that the entire kernel except the germ is made up of soft, starchy or floury appearing material. There is no hard, horny material. It has been frequently used to adulterate wheat flour. It is supposed that this was the corn originally grown by the Indians.

FLINT CORN

The flint varieties are smaller and earlier than the dent varieties, and are grown in those sections or states north of what is known as the "corn belt." When flint corn begins to ripen and harden, the kernels glaze, or harden, on the

FIG. 81—Three well-balanced stalks in a single hill with three good ears weighing forty-two ounces. If each hill bore only half as much, the yield would be sixty-six and one-half bushels per acre, or more than double that of the corn belt.

outside first, and as a consequence the crown and sides of the kernel are hard and "flinty," leaving the soft and floury portion in the center of the kernel. The kernels have no dent, and are broad and rounded, leaving deep furrows between the rows of corn on the ear. One stalk will often produce two or three ears, but they are generally small, with only eight or ten, or occasionally twelve, rows.

DENT CORN

Practically all of the corn produced in the great "corn belt" of the United States belongs to this class. There are many varieties, differing widely in color, size and time of maturity, but the indentation at the crown of the kernel, which gives to this class the name of "dent corn," is characteristic of all the varieties. The sides of the kernels are hard and horny, but the crown and the central portion are soft and starchy in appearance.

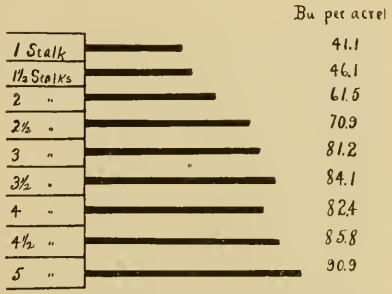

FIG. 82—Number stalks per hill experiment average of four counties, Story, Polk, Marshall and Page, Iowa, 1905. In each of the four counties, the experiment was repeated three times. Hills three and one-half feet apart each way. The corn was planted by hand. The one and one-half kernels per hill were planted one kernel in the first hill, two kernels in the second hill, etc.

VARIETIES OF CORN

THE IOWA SILVER MINE

This is a medium-early white corn, very popular in many sections, and well adapted to the northern half of Illinois and the southern two-thirds of Iowa. The ear carries its size well down to the tip, has from sixteen to twenty rows, and should be from seven to seven and one-fourth inches in circumference and about nine inches long. The kernels are rather thin, but deep, with a pinched dent, giving a rough appearance. The kernel is a tapering wedge, with straight sides and rounded tip, but is inclined to be somewhat chaffy. Matures in one hundred and ten to one hundred and twenty days.

This variety was originated by J. H. Beagley, of Ford County, Illinois, from a sample of corn exhibited at the County

Farmers' Institute. After several years of close breeding the type became remarkably well fixed. At this time the Iowa Seed Company bought Mr. Beagley's entire stock and named it the "Iowa Silver Mine." It is one of the best white corns, especially adapted to the medium and thinner soils. Unusual care should be taken in planting the Silver Mine corn. Owing to the broad, deep kernel, there is danger of a thin stand unless the proper plates are used in the planter.

THE LEAMING CORN

The Leaming variety of corn was developed by J. S. Leaming while living at Wilmington, Ohio. Mr. Leaming began making selections for seed from the yellow corn grown in Hamilton County on the "Little Miami Bottoms." This was in 1826. As soon as the husks indicated that the corn was beginning to mature, Mr. Leaming would go through his corn, selecting or marking seed ears for next year's planting. He sought ears well filled with straight rows of kernels and ears that were among the earliest to mature. He also took note of the character of the stalks growing these seed ears. Mr. Leaming selected his seed corn for fifty-six years with the idea of fixing a definite type. His son, J. S. Leaming, Jr., continues his father's work of selection.

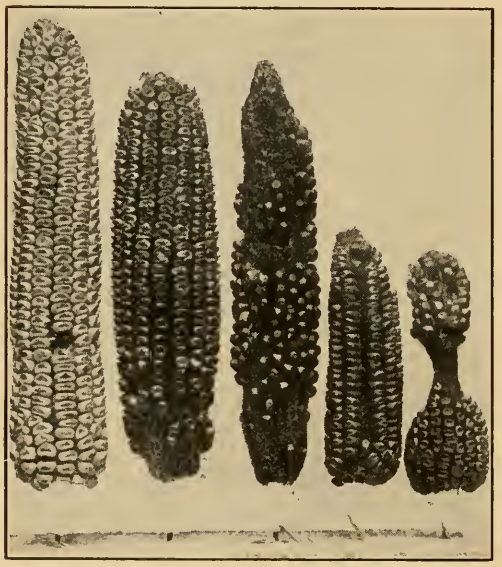

FIG. 83—Scrubs. The stalks upon which these ears grew produced millions of grains of pollen to fertilize the silks of the good ears.

Mr. Chester, of Champaign, Illinois, obtained seed from Mr. Leaming in 1885. Since that time he has been selecting seed

corn from those ears showing the first ripened husks. He has practiced planting this corn in isolated fields to prevent crossing.

This variety of corn has shown some characteristics that appear quite marked. The ears are tapering, number of rows sixteen to twenty-four, with a tendency to drop rows near the middle or tip of the ear; kernels wedge shaped, with square-set corners and nearly straight edges, indentation long or creased to pinched dent; color of grain a clear yellow; size of ear differs with locality where raised; the butts and tips are not as uniformly regular and symmetrical as in the case of Reid's Yellow Dent corn.

FIG. 84—Two different men's corn, grown side by side under the same conditions. The seed was taken from their planter boxes and planted by hand, three kernels per hill. One man's seed was harvested in November, and he did not "go to the trouble" of testing six kernels from each ear. He "never had any trouble with his seed corn." His yield was 34.6 bushels per acre, with half a stand. The other man's yield was 67.2 bushels per acre. He was willing to "go to the trouble of testing six kernels from each ear."

It is certain that many of our present varieties of yellow corn have been developed from the Leaming seed. The Leaming corn is now quite generally raised in manrady ts of the corn belt. It is a good yielder and particularly strong and vigorous, earlier than the Boone County White, but later than the Silver Mine and Reid's Yellow Dent, and especially adapted to the

central portion of the corn belt. Matures in one hundred and fifteen to one hundred and twenty-five days.

THE LEGAL TENDER

While shelling corn in 1876, Nims Brothers, of Emerson, Iowa, noticed two distinct types of ears. One was a short ear with deep grains and from twenty to twenty-four rows of kernels, the other was a long ear with from twelve to sixteen rows and well-formed kernels. By crossing these two types a variety was developed by careful selection of seed which has been followed up for twenty-seven years. The points of excellence which the Nims Brothers have attempted to secure are as follows:

1. Early maturity.
2. Large yield.
3. Pure yellow corn.
4. Ears carrying size well from butt to tip.
5. Kernels holding full size well to tip of ear.
6. Grains holding size well down to cob.
7. Butt and tip well filled out.
8. Cob small and not too large.
9. Kernels firm on cob. Ten grains laid end to end should measure six to six and one-half inches.
10. Small, neat shank, easy to husk.

The ideal Legal Tender ear should have twenty rows, have a circumference three-fourths of its length, should be ten to twelve inches long, seven to eight inches in circumference, should shell out twelve to fourteen ounces per ear and give eighty-six per cent. shelled corn. Time to mature one hundred and twenty to one hundred and thirty days.

REID'S YELLOW DENT

Mr. Robert Reid moved from Brown County, Ohio, to Tazewell County, Illinois, in the spring of 1846. He brought with him a variety of corn known at that time as Gordon Hopkins corn. This was a reddish-colored corn grown quite generally in the Red Oak settlement, where Mr. Reid lived.

Mr. Reid planted this corn on his newly purchased farm near Delavan, Illinois. It was late in the spring before it was planted, and his harvest showed immature corn, though it gave

L of C

a fair yield. Mr. Reid selected the best of it for seed the next year, but on account of the immaturity of the corn he had a poor stand. The field was replanted, or rather planted in with seed of the Little Yellow corn. It thus became mixed corn, but was kept pure from that time onward. Thereafter, from 1847 to date, fifty-seven years, this corn has been carefully selected for certain characteristics.

The peculiar dimple dent and shape of kernels with creased germs, the shape of ear, remarkable filling out of tips and butts, the high per cent of corn to cob and a finished or cultured appearance are among the strongest characteristics of the Reid's Yellow Dent corn.

Occasionally a very deep yellow, or even reddish yellow, appears, but generally the grain is a light or pale yellow. There is seldom but little soft corn, even the nubbins being solid. The original type shows a tapering ear, small and poorly filled out, with a small number of rows of kernels.

This offers one of the best illustrations of the value of intelligent selection. This variety is one of the best bred varieties of yellow dent corn. The original type of kernel was of the shoe peg style with the dimple dent. This seems to be giving place to a broader kernel and an elongated rather than a dimple dent. The former kernel has a smooth seed coat. There is a uniformity of color, finish and shape of ear which has made it a great favorite in the ring. During the last few years Mr. Reid has been breeding toward a rougher type, which gives a deeper kernel and a larger, later corn.

This corn has sometimes been known as the "World's Fair" corn since the Chicago Exposition in 1893, where it won first prize. During the last few years it has come into prominence, and is now extensively grown in central Illinois and is rapidly extending westward. In Illinois it is considered a medium-early corn. It seems to be well adapted to the north-central portion of the corn belt. This would be represented by the region lying between Bloomington and Chicago and by the south half of Iowa, although many parties are growing it successfully as far north as Mason City, Iowa. This variety has won more premiums in the great corn contests than all the other varieties put together.

This corn is a standing testimony to the good work of Mr. James Riley. Mr. Riley lived in Boone County, Indiana, and has rendered a valuable service to the world by his work in the breeding of corn. Mr. Riley had a large variety of corn known as the White Mastodon. In 1876 he picked over his seed of this corn, selecting for what he believed a desirable type of corn. He planted this special seed in an isolated field, and began changing the large, coarse type of white corn by selection. After several years of careful study and selection he produced the type of white corn he desired to raise, and named it after his home county.

The kernel is a large, broad, deep kernel, approaching the broadly rounded wedge type, with a good full tip, upright attachment at cob and fitting well together in the row from tip to crown of kernel. The dent type is moderate to deep creased dent with slightly roughened projections. There should be no approach to the pinched dent, as this reduces the thickness of the kernel crown, an undesirable feature in the Boone County White. This corn is one of the largest of the white corn varieties, and therefore must have a longer season to mature than the Silver Mine. The shape of the ear is slowly tapering, length approaches ten inches and has an average circumference of seven and one-half inches. It matures in from one hundred and twenty-five to one hundred and thirty-five days. It is well adapted to the southern half of the corn belt—that is, south of a line drawn through Burlington, Iowa.

Mr. Riley seems to have been one of the first corn raisers who sought to increase the productiveness of his corn by cutting out the barren stalks, improving both the yield and quality of his corn. When the type he sought to fix has been modified by both the grower and the region where grown, still it remains one of the most distinct and best varieties of white corn, with well-shaped kernels, firmly set on a medium to large-sized cob. It is especially well adapted to rich, strong soils and to river bottoms. It does not stand drought as well as the Silver Mine, but is a large yielder under favorable conditions. It requires a long season to mature, but ripens well in the south half of Indiana and Illinois and in the very southern part of Nebraska, the south-

western part of Iowa and through Missouri and the eastern part of Kansas.

RILEY'S FAVORITE

This variety is a yellow dent corn originated by Mr. James Riley in 1885. Mr. Riley desired a larger corn than the Pride of the North, quite generally raised in the northern portions of the dent-corn belt, yet one that would mature in his locality in Indiana. He therefore crossed two varieties, producing a hybrid corn. This he carefully planted year by year in an isolated place. Here he gave it the best of culture, cut out the diseased, weak stalks, permitting only the hardy and more vigorous stalks to bear pollen. Mr. Riley named this variety "Riley's Favorite," and sought by selection to fix a type of desirable yellow corn that would mature in but little more than one hundred days. For this reason he selected for seed a medium-sized ear with small cob from a stalk of medium height. He and others have found much trouble in fixing a definite type of this corn. There seems to be a tendency to revert to one or the other of the crossed types.

The type Mr. Riley seems to have sought was a dent corn with a slowly tapering ear nine inches long, seven inches in circumference; rows distinctly paired and straight; number of rows fourteen to eighteen, with sixteen as an average; pinched dent, with tendency of kernels to be beaked; kernels straight, wedge shaped, with a moderately rounded tip; cob red and small; shank attachment to stalk medium to small; color of grain a clear yellow. Matures in one hundred to one hundred and fifteen days.

It is not possible, nor would it be profitable to go into an extended description of the multitude of different varieties of corn in the United States, but enough has been said to show how some of the best varieties have been developed.

Not more acres of corn, but "another nubbin of corn to each hill," should be the motto of every farmer in the corn belt.

One small ear of corn to each hill on the 3,556 hills per acre will make a yield of thirty-eight bushels.

LITTLE "NUBBINS"

Drudgery is labor without thought.

Poor seed means poor stand and weak stalks.

Getting our heads into the game is half the battle.

The farmer who makes two ears of corn grow where but one grew before is a "public benefactor."

There are many things which will reduce the yield of our corn crop even though we plant the best of seed.

Cause of low yield—poor stand; stalks "fooling around all summer doing little or nothing;" these are the greatest causes of a low yield.

The most precious thing in this world is the labor of a human being. Yet hours are wasted every day on vacant ground and worthless stalks.

To make a good crop of corn requires *good land*, *good seed*, *good care*, and back of all these must be a *great man*, a man who mixes brains with his labor.

No man has a moral right to himself and family, or to the community in which he lives, *to guess* that the 800 kernels on an ear will grow and produce strong plants.

"If the corn fields of the Untied States were mine and I could give but one order, that order would be, 'To test six kernels of corn from every ear of seed intended for planting.' "

Poor seed means missing hills, one–stalk hills, and weak stalks, producing little or nothing. It means wasted land and wasted labor. It means less than thirty bushels of corn per acre in the "corn belt," instead of forty or forty-five bushels.

If every ear of corn intended for planting next spring was harvested not later than the middle of October and hung up in the attic where it could dry out thoroughly before the bitter cold freezes of November and December, millions of dollars would be added to the value of next year's corn crop.

STUDEBAKER

Wagon Makers to the AMERICAN FARMER

THE unparalleled success of the American Farmer is largely due to his insistence upon having the best of everything in tools and machinery. He is shrewd enough to know that this, in the end, is cheapest. By meeting the demand for first-class farm vehicles and by utilizing every known means of improvement in materials and machinery, the Studebakers have achieved and maintained supremacy as makers of wagons to the American Farmer. The Studebaker Farm Wagon is practical. It is the strongest and lightest running wagon made. Every inch of wood in it is carefully selected, air dried and perfectly seasoned. Every piece of iron, every bolt, rivet and nail is without flaw. Every axle, skein, spoke, springs and bracing is tested far beyond its required strength. When you buy a Studebaker wagon, you get a wagon "with a reputation behind it"; a wagon made by the greatest vehicle concern in the world. The Studebaker plant covers 101 acres. Every class of wagon and vehicle for farm and agricultural service is made here by the greatest force of skilled craftsmen in the vehicle industry. **Over 1,000,000 Studebaker Vehicles are in daily use.**

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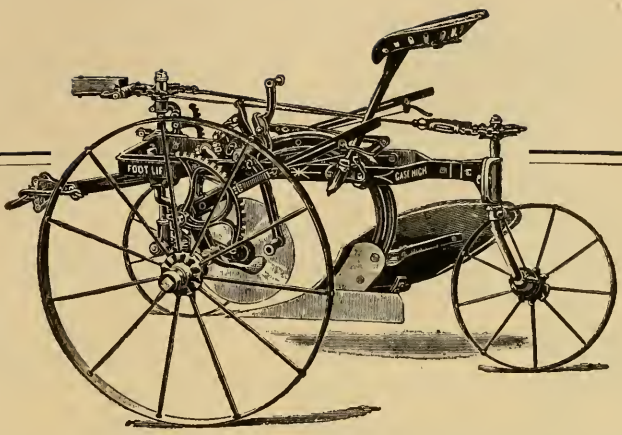

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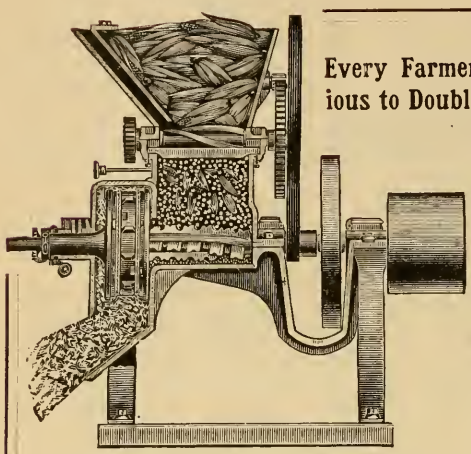

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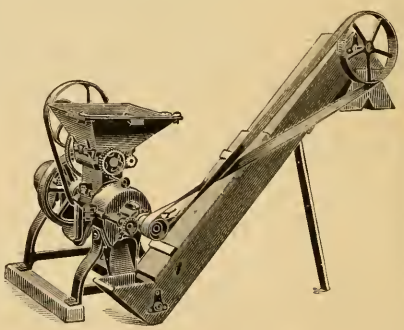

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